



Fig 1



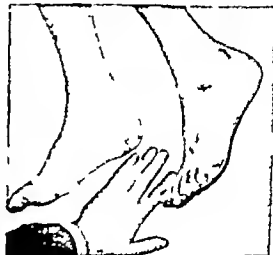
Fig 2



a



b



c

Fig 3

Fig 1 Case 7 Indolent ulcer before, a, and on the 10th, b, and, the 30th day of treatment.
 Fig 2 Case 6. Thromboangiitis obliterans on the 30th day of treatment, showing the healed ulcer of the stump.
 Fig 3. Case 8. Early gangrene of the feet before, a, and, b, on the 5th, and, c, 28th days of treatment.

*The Influence of Vitamin E on Vascular Disease—Eran V. Skute, Arthur B. Vogel, and
 Floyd R. Skelton and Wilfred E. Skute.*

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THE INFLUENCE OF VITAMIN E ON VASCULAR DISEASE

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IN 1942 Mason (2) reported that the classical fetal resorption in E-deficient pregnant rats was due to such vascular abnormalities in the uterine wall as stasis, distention and thrombosis (notably venous). Occasionally these conditions terminated in ruptures into the decidua with frank hemorrhage. In E-deficient chicks analogous phenomena are also seen, and there is some evidence in them too of functional alteration of the capillary walls.

At about the same time Shute (6) stated that senile vulvovaginitis treated with high doses of the tocopherols often was clinically improved. Biopsy of vulvar tissue after such treatment revealed an appearance suggesting either the proliferation of new capillaries or the reopening of old collapsed capillaries. But the definite lag of 2 to 4 weeks before improvement showed itself suggested the former as being the more likely. On *a priori* physiological grounds it was the more tenable explanation, too.

Mason (3) has also pointed out that in both the monkey and hamster vascular degeneration is a prominent feature in the picture of prolonged vitamin E deficiency. Shute (8) has recently reported the rapid response to intensive tocopherol therapy of 3 patients with acute hemorrhagic nephritis, indicating an ef-

fect on the glomerular capillaries. Other observations (7, 11) we have made on the purpuras indicate that the tocopherols decrease capillary permeability and increase low platelet counts. However it was the influence of the tocopherols on coronary thrombosis and other cardiac processes (1, 3, 14, 15) that recently turned our attention directly to the effect of tocopherols upon pathological conditions of the vascular system. It was noted that many arteriosclerotic cardinals given tocopherols reported that feet and hands that had been cold and numb for years had suddenly become warm again. Many had had small indolent ulcers which now healed rapidly. We could scarcely fail to investigate certain types of peripheral vascular disease in following up such clues.

CLINICAL STUDIES

What follows is an account of our experiences with tocopherol therapy in a series of patients having vascular disease.

Thrombophlebitis and phlebothrombosis
Twenty two cases of this condition have been studied. Three typical examples will be described briefly.

CASE 1. Miss M. (courtesy Dr. R. Schram) aged 50 years. This girl developed an acute left femoral thrombophlebitis May 28, 1946, the third day post partum. The area involved was about 4 inches long in the left midthigh, and there was at the same time a phlebotic mass 3 centimeters in diameter in the left

the platelets out of circulation. Clinical improvement in these patients is coincident with a rise in platelet count and an apparent resorption of the fibrin mesh. On the other hand older and organized thrombi are usually associated with higher platelet counts, do not seem to screen out platelets and do not respond to the same dosage of tocopherols. Perhaps double the usual dose is required—often as high as 600 milligrams of the alpha form. Can it be that tocopherols attack fibrin directly by a proteolytic process? A decrease of platelets and a persisting high sedimentation rate on tocopherol therapy is an indication either of recurrence or extension, and demands an increased dose.

The bearing of these observations upon our views on cerebral and coronary thrombosis is too obvious to be labored here of course.

Should all puerperal women be given tocopherols in an effort to avoid thrombosis? Such therapy might also promote lactation in a few such women (5) but of course should not be instituted until the third day at least in toxemic mothers for fear of precipitating eclamptic convulsions (9). Many herniotomies and pelvic operations might benefit similarly from prophylactic dosage.

Indolent ulcers of the leg and ankle. We have studied 13 of these and will describe 4 typical examples.

CASE 4. Mr. H. aged 63 years a railway news agent. His right leg had been ulcerated at the ankle off and on for 19 years. There was considerable generalized arteriosclerosis and a normal blood sugar. The present exacerbation dated from 1945. When first seen by us on September 16, 1946 he had been in bed for a month with the right leg literally covered from toe to knee with old and recent open ulcers of all sizes up to 2 inches in diameter. During that month he had been treated with local applications with little or no relief. He was promptly given 250 milligrams of a tocopherol per day by mouth. He began to show improvement in a few days. Time was nearly healed in 8 weeks and was completely healed in 10 weeks. He returned to work November 16, 1946 and has been well since working on the rail road again.

CASE 5. Mrs. C. aged 6 years a wife living alone. For 18 years she had had recurrent varicose ulcers of both lower legs. She came under our observation in December 13, 1946 for a funus carcinoma. It was incidentally noticed at that time that her left leg was in an Unna's boot. Both shins were

badly scarred from old ulcerations. She had had an indolent varicose ulcer over the left internal malleolus for the previous 6 months, and had worn an Unna's boot during that period of time without much benefit.

The boot was removed she was curetted and given deep roentgen therapy and kept in bed. After December 14 she was given 300 milligrams of a tocopherol per day by mouth. In 10 days time the old ulcer had greatly improved and in 17 days was well healed. The leg has remained well since. She was discharged February 2, 1947. She is now quite active doing her own housework.

CASE 6. Mrs. A. aged 82 years had suffered from varicose veins of both legs since 20 years of age. She had had varicose ulcers occasionally since 30 years of age the last one appearing in 1938. The present episode began in August 1946. When first seen by us on December 7, 1946 there was a typical varicose ulcer over the internal malleolus of the left ankle. It was 3 centimeters in diameter with a dirty sloughing base. Several tiny ulcers were to be seen over the external malleolus of the same leg. Her urine was normal. She was put to bed for 9 days and given 300 milligrams per day of a tocopherol. There was so much improvement in the ulcer in that time that she was allowed up. By the 23rd day of treatment the ulcers were greatly improved and healing was complete on the 30th day. She has been well and active since.

CASE 7. Mrs. C. aged 54 years. This woman had been troubled with varices in the left leg since 1922. At that time she had had a venous ligation done. She had had phlebitis five times since once in both legs. In 1941 an ulcer developed over the left internal malleolus and it had never healed completely since. For the past 3 years it had covered the mesial and anterior aspect of the lower leg and when she presented herself it was about 4 inches in diameter square in contour with a stinking sloughing base.

She was admitted to hospital March 8, 1947. Her blood and urine were normal. She was afebrile. Her usual local treatment was applied and penicillin was used as well both intramuscularly and locally. On March 18 one of us suggested that the penicillin be discontinued and that she be given 5 milligrams of a tocopherol per day by mouth. She had steady and rapid progress thereafter getting out of bed after March 21. By March 25 the slough had all cleared away from the surface of the ulcer, the odor had gone, fresh granulation covered the whole bed and penicillin of epithelial tissue had grown in over the granular surface for as much as a centimeter in many places. By March 30 the epithelialization had progressed considerably in some places encroaching 3 centimeters or more into the ulcerated area. She was discharged from hospital on April 12.

The ulcer was next seen on April 26 at which time it was well healed except for an area at the center 3 centimeters in diameter. This was reduced to half its size by June 3. On July 10 the ulcer was completely healed.

All the other patients did as well as those described here.

The response achieved in these patients was both prompt and lasting. It was ascribed to improvement in local arteriolar circulation and to better oxygen utilization by the local tissues. During treatment the affected extremity sometimes became warmer than its mate.

These studies may bear on the problems of plastic surgery.

Early gangrene of the extremities. We have studied 3 such cases and will describe one of them in detail.

CASE 2. Mr McK (courtesy Dr W Harbilly) aged 74 years. He was admitted to hospital in London on March 29, 1941, displaying well areas of dry gangrene on the dorsum of both feet and legs, large deep gangrenous areas 2 1/4 inches in diameter in front of and behind the left lateral malleolus and a large area of dry gangrene over the right tendo achillis. Both legs were inflamed, discolored and edematous half way to the knees. The patient said he had been "itching around in the feet" in his boots for several days before admission. His hands were a dusky cyanotic color. The blood sugar a normal but the no protein nitrogen was 43 milligrams per cent and his sedimentation rate 76 N.E.S. Studies of his legs showed considerable calcification of the posterior tibial artery, much more marked in the left leg. The left popliteal did not pulsate and the right pulsed only very faintly.

Beginning on March 21 he was given 500 milligram of a tocopherol acetate per day by mouth. On the 26th he complained of pain and needles in his feet and a change for the better was apparent at the upper limit of his lesions. His feet and legs were no longer edematous. His hands were no longer cyanotic. On the 28th a pulsation in the left popliteal artery was first palpable. By the 30th most of the edema of the legs and the dorsum of the feet had sloughed off leaving normal pink skin underneath. At this time the more superficial gangrenous areas were rapidly healing under loosening scabs. By April 6 several of these had been cast off and a pulsation could be detected in both posterior tibial arteries for the first time. By April 18 his right leg and foot were almost normal in appearance. On the left foot only a few of the deeper scabs remained. On April 23 his nonprotein nitrogen was 43, creatinine 1.1 and sedimentation rate 35. The corresponding values on May 2 were 43, 1.1 and 17. By April 25 both feet were healed and the patient began to walk about.

When he went into hospital amputation of both legs above the knee seemed to be the treatment of choice. Amputation is no longer necessary. He still takes 500 milligrams a tocopherol per day.

The first case of early gangrene of an extremity treated with tocopherols was a woman of 76 years of age who was admitted to hospital December 8, 1946, for an acute diverticulitis which was promptly operated upon. Her left leg at that time showed early but discrete and superficial gangrenous areas extending as high as the knee. She was a mild diabetic under good dietary control but with arteriosclerosis. After December 11 she was given 100 milligrams of a tocopherol per day by mouth and soon showed great improvement in the affected leg. She was discharged from hospital on December 22, 1946, and has led an active life ever since doing her own housework. She still takes 5 milligrams of a tocopherol per day as a prophylactic measure. There has been no recurrence of her lesions.

What would tocopherol therapy do for frostbite, immersion foot, and similar conditions? Others with better clinical opportunities may provide the answer.

Thrombosis, angitis, scleritis and related vascular conditions. We have thoroughly studied one verified and one doubtful case.

CASE 3. M. M. T. aged 55, single. She has never used tobacco. She began to complain of pain in her toes in 1934. The toes became dusky red at times almost purple and gangrene was feared as these conditions became progressively worse. At that time a glaucoma and other such measures in hospital over a period of 15 weeks gave temporary relief. With Buerger's exercises and careful avoidance of overexertion a threat (she has always loathed her more than cold!) she maintained an approximate normal weight until July of 1946 although frequently during these intervening 12 years the toes were ulcerated. The greatest care was required to avoid a major foot infection and to heal these small ulcers. Once in 1942 she almost developed dry gangrene of several toes of both feet and was forced to spend 7 weeks in bed. The toes have been numb for years as has also been true of the feet and lower legs. When she wanted to pick up anything from the floor she could not kneel, steadily because of the numb feet but sat down in order to do so. She often awakened in the night to see if her feet were still there. There had been considerable edema of the feet and lower legs during these years, and this was not altered appreciably by a salt free diet.

On June 12, 1946, she was given 500 milligrams of a tocopherol acetate per day—our first case of peripheral vascular disease treated with the tocopherols. On the 15th she could scarcely sleep for the

tingling in her arms and legs and in the next few days purpuric areas of all sizes appeared over the trunk and extremities accompanied by sensations of "pins and needles." She had had these purpuric manifestations at her x ray menopause 10 years before but not in the interim. In 10 days time her edema decreased considerably and her toes felt warm and had practically returned to normal color. By July 23 her feet and toes were no longer numb. She now could kneel on the floor to work or pick things up. Trauma to the toes was now felt as pain. On three or four occasions she stopped her tocopherol therapy or reduced the dose but each time her edema and other difficulties recurred promptly. Her chiropodist could always detect changes in her dosage. Her corns began to trouble her again as soon as sensation returned to her toes and they regained their usual color. Actually it seemed to her that the corns grew faster than before. She is now leading a very active life as a practical nurse on a difficult case.

We are well aware of the fact that the diagnosis in this case is questionable and that to call it Raynaud's disease might be more accurate. However the vascular relief achieved provides our reason for presenting it.

CASE 10. Mr S. K., aged 48 a veteran of the last war. In the winter of 1944 he experienced a good deal of pain in his fingers and toes. They often felt intensely cold and would assume a dead white appearance. In June 1945 he was sent into hospital for a stubborn ulcer on the ball of the left thumb. The palmar aspect of the right thumb then displayed extensive areas of dead white skin and ached. His toes also were white but not as white as the thumb. They too were cold to the touch and ached. His other fingers ached constantly too. When the ulcer on the thumb healed other ulcers appeared on the tips of other fingers some of them on the other hand. A diagnosis of Raynaud's disease was made. In October of that year the ring finger of his left hand was ulcerated at the tip. Neither detailed examination by a neurologist nor laboratory studies were helpful.

On a later hospital admission in September 1946 an x ray examination of the hands revealed osteolytic reaction involving particularly the distal end of the distal phalanx of the third right finger and the distal phalanx of the right index finger. His feet showed similar changes involving the distal phalanx of the 2nd right and 2nd left toes and both 4th toes. The right 5th toe showed some proliferations and cystic areas suggesting a response to vascular occlusion. Two weeks later gangrene of the second right toe appeared with swelling and redness of that toe and foot. Only an occasional dorsalis pedis pulsation could be felt. The right popliteal was palpable. Injection of 8 milligrams of mecharyl produced a temperature elevation of as much as 1.2 to 2 degrees only in the first right toe, 4th right toe and in 1st, 3rd, 4th and 5th left toes. In the remainder the flushing response was less than one degree. On Oc-

tober 25 1946 the right lower extremity was amputated by the Gritti-Stokes method. As the stump failed to heal, skin grafts were attempted in November 1946 and January 1947 but both failed to take.

The pathological report on the amputated leg revealed thickened vessels, showing in one place an old organized canalized thrombus. There was intimal hyperplasia, a lymphocytic infiltration of the media and a thickened adventitia. The small vessels showed either marked narrowing of the lumina or organized blood clot filling them. There was no evidence of calcification anywhere.

The condition of the other leg rapidly became worse and when first seen by us on February 13 1947 he had been sent home on 2 weeks leave before returning to consider its amputation. The site of the unhealed skin grafts was a raw ulcer. For a fortnight he was given 300 milligrams of a tocopherol acetate per day by mouth but not required to reduce his cigarette consumption. By the 4th day of treatment he began to feel improvement. On the 8th day increased urination developed and he no longer experienced pain in his extremities. By February 24 his phalanges were normally warm and of good color. The recalcitrant stump ulcer was now completely healed and felt normally warm. On March 14 he was able to walk on his artificial leg for 4 hours without discomfort and his hands and remaining foot seemed nearly normal. He bought a truck and decided to begin a trucking business. However he was unable to get tocopherol capsules for a 2 week period in April. When he next reported on May 1 he showed a recurrence of the stump ulcer. He was promptly given tocopherols again and the ulcer healed as promptly as at first. He was working as a trucker when last heard from at the end of May.

Another typical case has had a fine result. It should be mentioned that these patients often suffer a good deal as their circulation improves. During that time they may be difficult to maintain on treatment.

Our former colleague, Dr C. K. Stuart, has treated with tocopherols 4 patients displaying intermittent claudication the results being excellent in 3 of them.

Our friend, Dr George Dowd, has treated 4 such patients between the ages of 48 and 63 years. Three of the patients became asymptomatic and one was markedly improved on doses of 400 to 1100 milligrams of mixed tocopherols daily. We have had a good result in the only case we have treated ourselves.

Cerebral thrombosis. After what has been said above on the subject of thrombosis in general, little need be added here. One of the more puzzling phases of our studies has been the trivial influence the tocopherols usually

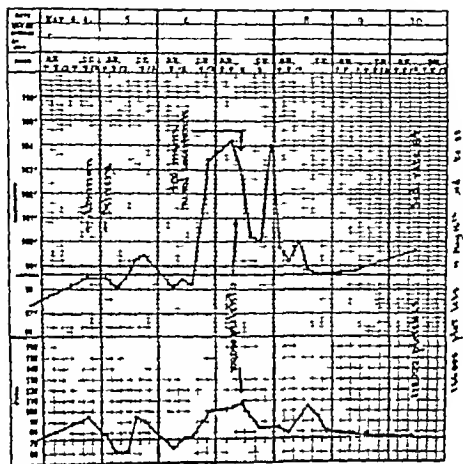


Fig. 4. Graph showing results of treatment with tocopherol only in a case of postpartal thromboembolism.

exist on hypertension *per se* but the fact that in hypertensive heart disease there may be a small initial rise of both systolic and diastolic blood pressures coincident with increased cardiac tone and relief of decompensation which is often followed by a drop a compensation occurs. The symptoms ascribable to hypertension are often relieved out of all proportion to the improvement thus achieved. This parallels the experience of Smithwick with his surgically treated hypertensives.

We have studied a score of cases of cerebral thrombosis, most of them of months or years, as 1/2 years standing. In 12 out of the 20 cases some improvement was often achieved. As would be anticipated, the patients treated most promptly did best. Generally speaking from 10 to 25 per cent of the disability has disappeared in the group as a whole. The gain was made principally within the first 3 weeks

after which improvement went on much more slowly. It is very difficult of course to prove how much of what was gained was ascribable to tocopherol therapy and how much was spontaneous. Others must settle that point whose opportunities are superior to ours. We merely discuss the topic here for its suggestive value and because it is pertinent to this whole problem. But Dowd tells us he has seen a 50 per cent improvement in a woman whose stroke occurred 6 years previous. If cerebral thrombosis occurs in end vessels, as medical texts have long contended, the theoretical interest of the type of case is further enhanced. One of our most interesting cases was that of an elderly lawyer who had experienced his accident in 1914, 2 years before he was first seen by us. His original complaint was a cerebral aneurysm of the middle cerebral artery. His condition was to be on a permanent

basis. His blurred vision dramatically improved in 3 weeks time. Before treatment he could distinguish a person standing 6 feet away but not his features. Afterward he could differentiate all his major features.

The benefit these patients experienced may have been strictly analogous to that seen in thrombosis elsewhere. Or gliosis itself may have partially responded as in Steinberg's cases of fibrositis and fascial contracture. Both Davison and Dowd suspect that some damaged nerve cells live in a twilight state, neither dead nor yet fully alive, until such a reparative stimulus as the tocopherols reach them and enable them to regain at least a portion of their former function.

If every hypertensive were given tocopherols would the incidence of apoplexy be reduced?

DISCUSSION

The number of patients studied in each of these groups is small, but the results are of such interest, developed so promptly and have such an important bearing on the great problem of heart and kidney disease in general that it was felt they should be reported now. The color photographs appended illustrate the rapidity and extent of some of the changes described.

One cannot but suspect that the surgical and medical possibilities of the field we have stumbled into will prove both fascinating and rewarding to investigators who have better opportunities than we have. Generally speaking the tocopherols should be helpful wherever improved arteriolar circulation or better oxygen utilization in tissues is desired (10).

It would seem that when tocopherols are administered thrombosed veins relax to permit a circulation over and past the thrombus, as Pereira has clearly shown can occur with sympathetic block in like cases. The analogies of our treatment to sympathectomy are of real interest.

The need for continued treatment at high dosage levels in so many cardiovascular conditions is analogous to the situation encountered in hypothyroidism or in diabetes. It suggests that one is either replenishing a rapid wastage of tocopherols in these particular pro-

ple or combatting the continued production of some noxious bodily antagonist. Our work with the purpura would perhaps suggest the latter and may even point to that agent as being the estrogens—another indication of the truth of our old thesis that vitamin E is anti-estrogenic whatever else it is.

The matter of dosage is fundamental in tocopherol therapy. About 200 to 300 milligrams of a tocopherol per day seems to be the average therapeutic level. The fact that it is a tocopherol that is required should be stressed. In cases of acute cerebral thrombosis we have used parenteral tocopherols with success. Patients so treated seem to react in one half to one third of the usual time taken when tocopherols are administered by mouth. To achieve the best results in such cases it is important to saturate the patient as early as possible in order to minimize brain cell damage adjacent to the thrombus or embolus. Inorganic iron should not be given with the tocopherols (10).

We have even been so bold as to hazard the guess—and it can only be that in the present state of our investigations—that the tocopherols may be at least as valuable in the prophylaxis of certain vascular accidents and conditions as in their therapy. In this connection it should be pointed out that many of these conditions soon recurred after healing unless tocopherol therapy was continued at a high level permanently.

For too long medical men have considered the vitamins to be mere food accessories. But surely the time is approaching when some of them at least will rank as true chemotherapeutic agents to be administered in doses comparable to those of the sulfonamides or penicillin and for indications quite as strict that Nature thought of them as being prophylactic before we thought of them for cure just as she left medicinal molds lying about for those to pick up who could see them under their feet.

SUMMARY

In such vascular diseases as indolent varicose ulcers of the legs, thrombophlebitis, early gangrene of the extremities and even thromb-

THE VISCERAL ENDOPELVIC FASCIA AND THE HYPOGASTRIC SHEATH

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EVER since John Cameron in 1908, called attention to the significance of what he called the "perivascular sheath" as a supporting mechanism of the pelvic viscera interest in the visceral endopelvic fascia has been on the increase and numerous attempts have been made to define display, and describe accurately this system of structures in the pelvic cavity So far, however, no accord has been reached in classifying and defining the component parts of the visceral endopelvic fascia. Moreover most of the existing descriptions of this structure do not lend themselves to an easy and clear cut demonstration in the student dissecting room nor do they fulfill the requirements of the practicing surgeon

Compelled by the need of presenting this subject to both medical students and post graduate students, the senior author of this article has been engaged for the last 10 years in a study of the visceral endopelvic fascia, certain phases of which will form the topic of the present contribution

It is generally agreed upon that the fasciae of the pelvic cavity can be grossly classified under two headings, the parietal and the visceral endopelvic fascia. There exists however no agreement concerning the individual fascial structures which should be considered parietal and those which should be termed visceral. In order to avoid misunderstandings, it is necessary that we define the terms to be used in this article

PARIETAL ENDOPELVIC FASCIA

Testut considered as parietal endopelvic fascia all fasciae which cover the pelvic surfaces of the muscles lining the pelvic cavity according to this author the fasciae

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These investigations were supported by grants from the Westover Research Fund of the University of Maryland.

which cover the pelvic surfaces of the internal obturator, piriformis, levator ani, and coccygeus muscles are parietal endopelvic fascia.

Cunningham (5 6) and following him Cameron (2) describe the fasciae of the muscles of the pelvic floor (levator ani and coccygeus) as parts of the visceral fascia. Under the term of parietal endopelvic fascia these anatomists include only the fasciae which cover the pelvic surfaces of the muscles of the pelvic wall proper (parietes) i. e. the internal obturator and piriformis, and peculiarly enough also the fascia of the deep transverse perineal muscle.

Again a different grouping we find in a paper by Douglas E Derry this author is of the opinion that the fasciae of the coccygeus and piriformis are entirely different from the true parietal endopelvic fascia and should be considered by themselves as individual fasciae. Only the internal obturator and levator ani fasciae are parietal

Many other views concerning this subject are encountered in the literature too numerous to be considered here

In the following account we have adopted essentially Testut's nomenclature the pelvic fasciae covering the internal obturator piriformis levator ani and coccygeus are parietal endopelvic fascia.

VISCERAL ENDOPELVIC FASCIA

Considering the complexity of the visceral endopelvic fascia and the lack of uniformity in the description of this structure, it is not to be wondered at that some authors became discouraged and relegated this entire fascial system to the position of an undifferentiated 'packing tissue'. Outstanding among the proponents of this procedure is Douglas E. Derry who demands that the term 'visceral endopelvic fascia' be dropped entirely and be replaced by the term 'subserous tissue'

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Even where the latter is condensed into perivascular sheaths and fascial capsules these structures are lacking in definition and pass gradually into the general, undifferentiated subserous tissue. We hope to show however that the visceral endopelvic fascia is disposed in the form of well defined, strong sheet like structures of definite location attachment, and function. Anybody who has read the classical work by Peham and Amreich, of the University of Vienna, entitled *Gynaekologische Operationslehre* will admit the existence and demonstrability of the visceral endopelvic fascia, as well as the need for accurate knowledge and description of this structure.

To mention only a few of the most important functions and uses of the visceral endopelvic fascia, attention may be called to four of them

1. The visceral endopelvic fascia furnishes well defined capsules for the pelvic viscera. These capsules serve as points of attachment for important supporting structures composed of visceral fascia. Moreover the capsules contain the collecting channels of the lymphatic drainage system of the pelvic viscera. Surgeons are well aware that malignant growth if it once has broken through the wall of the viscus and invaded the capsule is prone to have formed metastases. Taking into account this fact, Jewett has recently worked out a classification of malignant growth of the bladder with respect to its operability.

2. In the form of double layered perivascular sheaths, this fascia serves as a vehicle for important vascular and nervous structures. An accurate knowledge of these sheaths enables the surgeon to locate swiftly these vessels and nerves.

3. The perivascular sheaths form partitions dividing the subperitoneal part of the pelvic cavity into fascial compartments which are completely sealed off against each other.

4. The perivascular sheaths are firmly attached to the fascial capsules and to the pelvic wall thereby mooring the viscera securely to the walls of the pelvis. As they run in different planes and are situated at different levels, they form a framework within which the viscera are suspended.

For practical purposes as well as for the purpose of teaching the component parts of the visceral endopelvic fascia may be classified as follows

1. Fascial capsules varying in thickness in different regions and enclosing the pelvic viscera. Where these organs pierce the pelvic floor the capsules become continuous with the parietal endopelvic fascia. For this reason they are often described as reflections of the parietal fascia upon the walls of the pelvic viscera.

2. A horizontal band of fascia described in the anatomical nomenclature under the name of fascia endopelvina, which arises from the parietal fascia of the levator ani along a line called the white line of the fascia endopelvina.

3. The umbilical sheath. This is a distinct fascial membrane located for the most part in the abdomen where it forms a thickened triangular band, the apex of which is attached to the umbilicus, while its two lateral sides correspond to the obliterated umbilical arteries. It contains in its midline the obliterated and laterally on either side the obliterated umbilical artery. In the pelvis it becomes continuous with the capsule of the bladder and, more laterally with the superior hypogastric fascia. In the abdomen it represents a part of the visceral endogastric fascia located between peritoneum and transversalis fascia and is especially well differentiated in newborn children. Its nature and origin have been discussed and explained by two French anatomists, Cuneo and Veau.

4. The superior hemorrhoidal sheath a distinct perivascular sheath differentiated from the dorsal visceral endogastric fascia around the branches of the inferior mesenteric artery. It descends down into the pelvis behind the rectum and fuses with the pelvic hypogastric wing to be described in detail in this article.

5. The hypogastric sheath, an extensive and well defined double layered fascial membrane which arises over the anterior hypogastric artery and gives off a number of wings.

6. The rectovaginal (rectovaginal) septum although not of fascial origin, must be mentioned.

tioned here because of its intimate fascial relationships. It is a well defined membrane interposed between the rectum dorsally and the bladder and prostate gland (vagina in the female) ventrally.

7 And finally the loose areolar tissue this is present in relatively small amounts in the spaces between the viscera and fascial sheets. It is found also sandwiched in between the two fascial layers of which the perivascular sheaths are made up containing embedded in it the vessels, nerves and other structures. The present account is intended especially to call attention to and present a description of the hypogastric sheath and its components. In addition the rectogenital septum which has been described in detail in another article, and its fascial relations as well as the fascia endopelvina will be referred to.

HISTORY OF THE HYPOGASTRIC SHEATH

Since the hypogastric sheath will form the major topic of this article it is appropriate that we discuss briefly the history of our knowledge of this structure.

According to Testut Latarjet's *Traité d'anatomie humaine* this structure was first described by Jarjavet, Abernethy and Fara beuf under the name of *Gaine hypogastrique*. These authors however as well as Testut did not see anything else of this structure but a packing tissue around the anterior division of the hypogastric artery filling in a space dorsal to the peritoneum the "pelvirectal space".

Cameron (2 3) a Scottish anatomist, in 1908 was the first one who described the hypogastric sheath under the name of perivascular sheath, as a well defined structural entity and recognized its importance as a mechanism of support and fixation for the pelvic viscera. To give expression to this specific function he suggested for it the name of "fascial mesentery" of the pelvis. While his description was incomplete and did not include all the components of the hypogastric sheath, his anatomical studies must be considered as the starting point of our knowledge of this structure.

In 1930 Peham and Amreich made the hypogastric sheath the basis of their de

scription of the visceral endopelvic fascia. Aside from the fact that they did not include all the components in their description, they used an unfortunate nomenclature homologizing certain fascial elements with one another which in reality are of entirely different nature and origin. We shall have occasion to refer to their views later on in the course of our discussion.

MATERIAL

The following description of the visceral endopelvic fascia rests mainly on the dissection of the embalmed pelvis of a colored female 29 years of age and recorded as Series 479a 1946. While the dissection was in progress its individual steps were recorded by a number of illustrations. Eleven of these are reproduced in this article, numbered successively as Figures 1 to 11. Several additional illustrations taken from dissections of other cadavers and supplementary to the illustrations of the pelvis 479a 1946 are denoted by a small letter placed after the figure number (as for instance 6a).

Special features of the specimen. The pelvis was divided into two halves by a median sagittal saw cut. The left half was left intact with the peritoneum undisturbed. It served for comparison of important landmarks while the right half of the pelvis was in progress of dissection.

In Figure 1 the left half of the pelvis with the peritoneum in place is shown. In the dissecting room we rarely ever see a normal female pelvis, a very great handicap in the study of female pelvic anatomy. This woman however had no other gross pathology but that her tubes were closed on both sides. But she possessed a very unusual anomaly the ligament of Mackenrodt was completely separate from the flaccid part of the ligament latum. A wide gap existed between them only their uterine ends were connected by a narrow pontoneal fold.

On the dorsolateral wall of the pelvis there was seen in this specimen a peritoneal fold (recorded as ridge No 8) about 1 inch wide passing caudally and ventrally. Dorsally it had a sharp falciform boundary its ventral border was round. The ventral half of its

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width was seen passing forward, under the broad ligament, toward the bladder it contained, as we will see later on, the ureter and inferior vesical vessels. Its dorsal half at a point quite a distance ventral to the ischial spine, made a turn medially and became attached to the uterus. Judging from the contents of this fold it represented as far as sex is concerned, a nonspecific structure. Only the short portion from the point where part of it turned medially toward the uterus proved to be specifically female, representing the cardinal ligament of Mackenrodt.

RECTOVAGINAL SEPTUM

The pouch of Douglas extended exceptionally far caudal in this specimen. The bottom of the pouch was only 30 millimeters (a little more than 1 inch) cranial to the floor of the pelvis. Nevertheless, as Figure 1 shows a distinct rectovaginal septum was present. It is of interest to notice that the septum was attached to the dorsal wall of the vagina from the rectum it was separated by a quantity of loose connective tissue. When the uterus and with it the vagina were pulled forward the septum followed the vagina. This condition corresponds to the situation as it exists in the male there the septum is always introduced into the prostate gland. If a finger is through a transverse perineal incision, the operator may feel reasonably certain, that the rectovaginal septum will be in front of his finger separating the finger from the vagina while dorsally the finger will be in direct contact with the rectum.

In Figure 2 a dissection is illustrated which was made to display some of the relations of the rectovaginal septum in greater detail. Cranially the rectovaginal septum is attached to the peritoneum of the pouch of Douglas its caudal end could be followed all the way down to the pelvic floor. While in many adult specimens the line of fusion is marked at the bottom of the pouch by a white line and some strong peritoneal cords bridging over this white line (as will be described in detail in another article) the inner surface of the peritoneum of the rectovaginal pouch was entirely smooth in this specimen. The

cranial end of the septum had remained separated into two limbs representing its original two layers each limb was continuous with the peritoneum of the corresponding wall of the pouch and the line of fusion, instead of being bridged over by separate cord like binders, had been grown over by a continuous layer of peritoneum.

Special pains were taken to check the statement made by Curtis, Anson and Beaton in a recent article (7) according to which the tissue separating the vagina from the rectum is composed of the fascial capsules of these two viscera and some loose cellular tissue intervening between them. It was found that the rectovaginal septum is a structure additional to and well differentiated from, the capsules of both the rectum and the vagina.

Another important relationship is shown in Figure 2. The capsule of the genital viscus is attached by its cranial end to the peritoneum beyond this point over the body and fundus of the uterus, a fascial capsule could not be demonstrated as a structure independent of the peritoneum. This condition is the rule and is well known. Exactly the same relationship holds true for the ventral portion of the fascial capsule of the rectum, as is shown in this dissection. We have found however subjects in which the ventral rectal capsule extended all the way up to the colon.

HYPOGASTRIC SHEATH AND MAIN ANCHORAGE OF PELVIC VISCERA

In Figure 3 the right pelvis is shown after most of the peritoneum had been removed. The bladder was pulled medially permitting a view into the space of Retzius both its ventral and lateral compartments can be seen. The two structures, representing the main anchorage of the pelvic viscera, are displayed. They are (1) the root of the hypogastric sheath (2) the fascia endopelvina. The fascia endopelvina forms the floor of the space of Retzius the root of the hypogastric sheath seals off the space of Retzius dorsally. The fascia endopelvina occupies a nearly horizontal plane while the root of the hypogastric sheath lies in a nearly vertical and almost frontal plane if a hand is introduced into the space of Retzius and pushed

dorsally along the lateral surface of the bladder, it slides at first along the fascia endopelvina, as far back as the ischial spine. At that point its further dorsal progress is blocked by the root of the hypogastric sheath. Further movement is then possible only in a direction cranially and ventrally along the hypogastric root, which is directly continuous with the fascia endopelvina, but forms with it an angle of approximately 90 degrees. From this account it will be seen that the main line of attachment of the pelvic viscera imitates in direction the shape of the pelvic viscera themselves, most caudally their direction is nearly horizontal after making a bend of nearly 90 degrees, they are running in a vertical direction.

Peham and Amreich recognized this correlation between the direction of the pelvic viscera and the direction of their main anchorage line. They call the fascia endopelvina the 'horizontal groundplate' the hypogastric root the 'frontal groundplate'. This nomenclature, however fails to consider that these two elements are of entirely different nature. The hypogastric root and its derivatives are essentially perivascular sheaths. The fascia endopelvina is of the nature of a true ligament, partly aponeurotic in texture and is in addition a secondary formation characteristic of man but missing in lower forms.

Figure 3 permits a gross orientation of the components of the hypogastric sheath. The hypogastric root (fascia hypogastrica dorsalis) is attached to the wall of the pelvis along a line corresponding approximately to the dorsal border of the superior ischial ramus and ends caudally at the spine of the ischium which can be palpated by a finger thrust into the lateral compartment of the space of Retzius. It arises from the parietal endopelvic fascia over the anterior division of the hypogastric vessels and over the ureter (Fig. 3). Like all its derivatives it is composed of two fairly stout membranous layers between which the ureter the vascular and nervous structures are sandwiched in embedded in some loose areolar tissue. In Figure 3 only the lateral layer of the hypogastric root is visible the medial layer will soon be demonstrated.

The hypogastric root passes forward, toward the bladder and is divided by this organ into two wings a superior hypogastric wing (fascia hypogastrica superior) and an inferior wing (fascia hypogastrica inferior). Dorsally and medially it gives off an extensive double layered membrane the presacral hypogastric wing (fascia hypogastrica presacralis).

THE HYPOGASTRIC WINGS

With the aid of Figure 3 we will now discuss the hypogastric wings slightly more in detail.

a Presacral wing. The presacral wing extends from its origin all the way across the pelvic cavity in front of the sacrum and in front of the parietal fascia covering the piriformis and coccygeus muscles meeting in the median line its fellow from the opposite side. The superior hemorrhoidal vessels enclosed in a special sheath, the superior hemorrhoidal sheath, are incorporated into the presacral wing. Where it hits the rectum it splits into its dorsal and ventral layers, embracing the rectum and furnishing for it its fascial capsule.

Cranially the presacral wing is very wide. Further caudally as it follows the curvature of the rectum it narrows down and passes forward together with the rectum, forming a fascial wing of the rectum which attaches itself laterally to the fascia endopelvina.

Between the presacral wing and the parietal fascia a space is formed, the retrorectal space. Laterally this space is sealed off against the lateral compartment of the space of Retzius by the hypogastric root. Lowley and Kirwin (p. 947 vol. 2, 2d ed.) state that the space of Retzius extends as far back as the rectum. We feel it of importance to emphasize that a hand carried back in the lateral compartment of the space of Retzius is stopped on its way to the rectum by the root of the hypogastric sheath which forms the dorsal wall of the space of Retzius and represents a partition between the space of Retzius and the retrorectal space. We will see presently how communication between these two fascial compartments can be created.

b Superior hypogastric wing. As seen in Figure 3 the superior hypogastric wing follows the lateral margin of the superior surface of

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the bladder. There it splits open into its two layers one of which becomes continuous with the fascial capsule on the superior the other with the fascial capsule on the inferolateral surface of the bladder. Ventrally it is continuous with the umbilical sheath and that part of visceral endogastric fascia which lies between the peritoneum and the transversalis fascia. Laterally it sweeps across the lateral compartment of the space of Retzius, forming the roof of this fascial space and passing up on the lateral pelvic wall, to be come continuous with the visceral endogastric fascia in the iliac fossa. In order to be able to pull the bladder medially we had to cut through the superior wing its medial (pelvic flap) contains the umbilical artery and, as we will see later on in a medial view (Fig. 6) the superior vesical branches of this artery. The lateral flap of the superior hypogastric wing passes over the hump of the pelvis, forms a fascial sheath around the iliac vessels and is continued into the iliac portion of the visceral endogastric fascia (Fig. 3).

Peham and Amreich describe (p. 197) this superior hypogastric wing under the general heading of *Das lockere Bindegewebe am plying for it the name of Lamina ligamenti umbilicalis*. In this interpretation of the lateral wing they follow evidently those who consider the entire visceral fascia of the abdominal cavity as an undifferentiated layer of extraperitoneal fat, subserous cellular tissue etc. We possess a dissection which we made in 1941 and in which the capsule of the bladder has been dissected as a continuous sheet all around the organ with the two superior hypogastric wings attached and their fascia preserved. In this specimen these wings have been demonstrated as stout, well resist considerable pull an observation which holds true for the entire hypogastric sheath. Upon studying this fascia one understands why some of the older anatomists, such as for instance Hesselbach, clung to the description of the peritoneum as a duplicate composed of an internal and an external peritoneum, even after Ruyach and, later on, Douglas, in whose book the history of this

subject may be found discussed, had separated the outer layer under the name of *membrana cellulosa* (Ruyach) or *"membrana vesiculosa"* (Douglas) from the true peritoneum.

c. *The inferior hypogastric wing*. The inferior hypogastric wing is of special importance. It represents one of the major mechanisms of fixation of the bladder and contains the ureter and the inferior vesical vessels. In cystectomy this wing must be cut through in its entire length. The urologists are therefore especially mindful of this wing it is the same structure which Hugh Jewett calls the inferolateral ligament of the bladder.

In Figure 3 we see its lateral surface (its medial side will be shown later on). It comes down from the root of the hypogastric sheath medially it is attached to the dorsolateral margin of the bladder laterally to the fascia endopelvina.

Shining through the lateral layer of this wing we always see the plexus of Santorini and several stout venous drainage channels of the plexus the inferior vesical veins. It has already been mentioned that the most caudal narrow portion of the presacral wing is attached laterally to the fascia endopelvina. And now we have learned that the inferior hypogastric wing is likewise attached to the fascia endopelvina. Presently we will see that two other leaf-like structures the fascial wing of the vagina and the rectovaginal septum, are attached to the medial edge of the fascia endopelvina.

THE FASCIA ENDOPELVINA

As mentioned the fascia endopelvina is the structure which forms the horizontal floor of the space of Retzius. Under standard conditions it arises from the levator ani fascia along the whiteline of the fascia endopelvina, a line which passes from a point lateral to the inferodorsal end of the symphysis pubis to the ischial spine. The manner of origin and condition of its special differentiations is subject to very great variations which to discuss is not the object of this article. Suffice it to say that the line seen in this specimen is (Fig. 3) not the white line of the fascia endopelvina, but the arcus tendineus of the levator ani

a second line which ordinarily runs cranial to the white line of the fascia endopelvina. In this case this fascia had no special white line it came off the levator ani fascia a little caudal to the arcus tendineus.

The most ventral part of this fascia was in this subject, differentiated into three stout ligaments or expressed more correctly it formed a fascial investment for these three ligaments. Most medially the fascia had been cut away to expose the medial pubovesical ligament and the lateral pubovesical ligament. The former we have found so far in every subject examined, female as well as male it contained wherever we looked for them reddish muscle fiber bundles which radiate out into the superficial layer of the detrusor vesicae intermingling with its fiber bundles. The lateral pubovesical ligament is found more rarely.

Further dorsal the fascia endopelvina appears as a tough band which is of white color and ends dorsally into a sharp crescentic margin the lateral true ligament of the bladder. This term is rather incorrect, since in reality this ligament is connected to the bladder only by the intermedation of the inferior hypogastric wing and since it serves also and in exactly the same manner for the attachment of vagina and rectum. However it seems unnecessary to change this generally employed nomenclature. This ligament is considerably variable we have found specimens where several crescentic margins were interposed in its course. It can be very short or as in the present case, very long it measured in this subject fully 59 centimeters (over 2 inches).

Dorsal to the crescentic margin of the ligament the fascia endopelvina comes off at a lower level and cannot be seen in this illustration. It was necessary to tilt the upper end of the pelvis forward to expose the fascia endopelvina to full view such a view is illustrated in Figure 4.

THE PORTIO CARDINALIS OF THE LEVATOR ANI

After the fascia endopelvina has been incised, the aponeurotic fibers of the lateral true ligament of the bladder were exposed

The structure which interests us however is the one located dorsal to this ligament. Underneath the visceral fascia the fleshy bundles of the iliooccygeus exactly as in the male are seen as they pass, in steep course, caudally and medially covered in this situation by a rather thin parietal fascia. But immediately dorsal to the lateral true ligament of the bladder some special levator ani fibers, mixed with aponeurotic fibers leave the major portion of the muscle and pass into the inferior hypogastric wing (Fig 4). Because of their functional significance for the cardinal ligament, we have called these fibers the portio cardinalis of the levator ani. In our specimen, this portion was approximately three-quarters of an inch long. We want to emphasize the location of these fibers they correspond in location not to the ischial spine, but are situated about an inch and a quarter ventral to the spine.

In Figure 5 a window was cut out of the inferior hypogastric wing to expose its contents. Also the superior wing was cut away from the bladder through the gap created thus, the cervix is exposed to view. The ureter and the inferior vesical vessels are seen running forward to the bladder. But just opposite the place where the special levator ani fibers are located, the uterine vessels make a sharp turn medially to enter the ligamentum cardinale. We will come back to this relation between the root of the cardinal ligament and the cardinal portion of the levator ani when we will inspect the inferior wing from its medial side.

APPROACH TO THE RECTUM FROM THE SPACE OF RETZIUS

At the caudal end of the root of the hypogastric sheath there is located an arch like toughening of the fascia (Fig 5) in exploring the lateral compartment of the space of Retzius this arch can easily be felt with the fingers. Frequently in the embalmed cadaver a hard cord like structure may be felt through the fascial covering of the arch, the nature of which will be mentioned later. Laterally this arch is attached to the ischial spine which can also be palpated with the fingers. From this origin this arch passes forward and me

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dially to be continued into the inferior wing of the hypogastric sheath, as illustrated in Figure 5. In our specimen another arch-like structure pointing dorsally with its cavity was present it marked the dorsal end of the fascia endopelvina. The space between these two arches was bridged over by fascia (Fig. 5) which indicates the transition of the hypogastric root into the fascia endopelvina. In many instances this fascial bridge is formed by fascia which is so thin that a finger may be thrust through it in other cadavers it is merely composed of some loose orange-colored fat.

We made an incision through this fascia and introduced a piece of rubber tubing through the hole created thus. Pushing the rubber tubing dorsally we observed that it appeared in the retrorectal space, between the presacral wing and the parietal fascia. In this subject the rectum was situated very asymmetrically its largest part lying to the left of the median plane. In most subjects the rubber tubing would have come out dorsal to the rectum. A second piece of rubber tubing was introduced through the incision in the fascia endopelvina, just dorsal to the cardinal portion of the levator ani without any resistance it could be pushed into the retrorectal space. As this illustration shows an incision through the floor of the lateral compartment of the space of Retzius, extending from the dorsal end of the cardinal portion of the levator ani to the ischial spine will create a hole large enough to introduce a finger. The finger can be pushed past the line of attachment of the inferior hypogastric wing to the fascia endopelvina into the retrorectal space and the dorsal circumference of the rectal wall can be palpated.

As mentioned previously the space of Retzius is sealed off against the retrorectal space, by the hypogastric root we have now demonstrated that it is partitioned off against the retrorectal space also by the floor of the space of Retzius. We have demonstrated furthermore, how we can create access from the space of Retzius to the dorsal side of the rectum. This approach to the rectum can be created without the necessity of opening the peritoneal sac.

THE INFERIOR VESICAL ARCH

In order to analyze further the inferior vesical arch a window was cut through the lateral fascial layer of the hypogastric root, through it we see the main inferior vesical vein as it passes from the bladder through the inferior hypogastric wing and inferior vesical arch into the hypogastric root.

So far we have found this arch in every subject in which we looked for it. It is by no means a specifically female feature but occurs alike in both sexes. Invariably we found a large inferior vesical venous channel passing immediately through this arch and frequently also an inferior vesical artery in Figure 5 this artery is exposed in the window of the inferior wing it could be traced through the fascia from the arch into the inferior wing as illustrated in Figure 5.

We believe that great emphasis should be placed upon this inferior vesical arch. Be cause of the readiness with which it can be palpated without opening the peritoneal sac, it serves as an important and easy to locate landmark just caudal to it the floor of the lateral compartment of the space of Retzius can be incised without injury to vessels or any other important structures, and access can be gained to the rectum.

And furthermore the inferior vesical arch is closely related to an anatomical mechanism which has the function of mooring the bladder to the pelvic wall. The arch is located just cranial to the place where the upper margin of the coccygeus muscle runs transversely across the space between the ischial spine laterally and the sacrum medially.

In our specimen this margin was apocoeu rotic and of the nature of a sharp falcliform edge. It was the cause of the existence of the arch at the dorsal end of the fascia endopelvina (Fig. 5). Behind this upper edge of the coccygeus muscle the terminal branches of the ventral division of the hypogastric vessels the inferior gluteal and internal pudendal vessels, are passing through the infra-punform space from the pelvic cavity into the gluteal region. Owing to this anatomical arrangement the hypogastric vessels where they give origin to their visceral branches are held firmly against the punformis muscle by

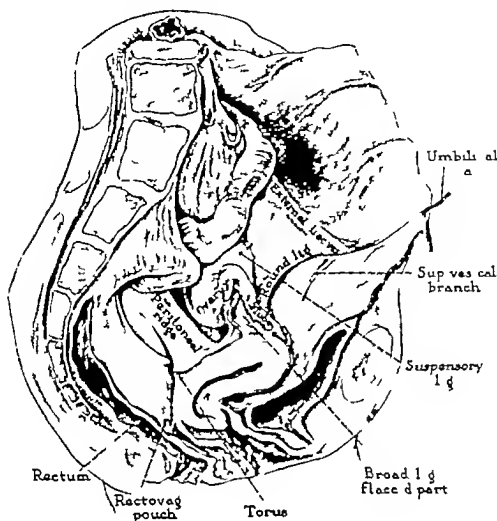


Fig. 1. Left half of pelvis of colored female (479 cm, 1946) 29 years of age. Peritoneum left in place.

the upper arched margin of the coccygeus muscle and are thus supplying an effective mechanism of counteracting any force which pulls on them in a ventral direction. The bladder has a tendency of being displaced forward and downward by the intermediation of the inferior hypogastric wing which arises just at the point of the inferior vesical arch and contains the inferior vesical vessels which in many cases are joined to the hypogastric vessels just cranial to the inferior vesical arch the bladder is securely moored to the pelvic wall.

It appears then that the inferior vesical arch is specifically associated with the bladder

and that the ischial spine marks the place of a specific mechanism for the anchorage of the bladder both in the female and in the male.

THE CARDINAL LIGAMENT (OF MACKENRODT)

Peham and Amreich consider the ischial spine as the place of origin of the cardinal ligament and the anatomical arrangement of the vessels which we have just discussed and which we consider specifically related to the fixation of the bladder is in the opinion of these authors a specifically female feature a mechanism of anchoring the uterus to the pelvic wall. A study of the male pelvis where

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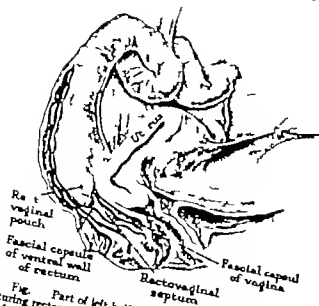


FIG. 2. Part of left half of pelvis shown in Figure 1, part of rectovaginal septum and its relationship to fascial capsule of rectum and vagina. Peritoneum left in place.

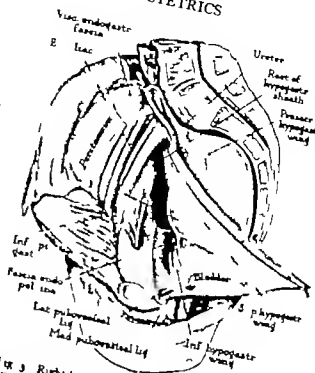


FIG. 3. Right half of pelvis of female 470 mm, 946 mm. Peritoneum largely stripped away. Superior hypogastric wing cut away from its lateral attachment. Bladder pulled medially and forward. Lateral compartment of space of visible.

exactly the same arrangement exists, as well as a consideration of the direction in which the uterus pulls, would make it difficult to follow Peham and Amreich in their interpretation. The pull which the uterus exerts upon the pelvic wall via the cardinal ligament is not directed forward but medially and downward.

In order to clarify this problem we must now turn to a study of the cardinal ligament which in this specimen as we have seen was completely separated from the broad ligament and could therefore be studied individually. For this purpose we will inspect a medial dissection of the same half of the pelvis, which we have studied so far from the lateral side. This dissection is illustrated in Figure 6.

The peritoneum had been largely removed. The superior surface of the bladder with its fascial capsule intact is seen. The superior hypogastric wing cut through along the pelvic brim is now viewed from its medial and cranial aspect. The umbilical artery and one of its superior vesical branches are shining through the fascial layer. At the apex of the bladder the transition of the superior hypogastric wing into the umbilical sheath and the continuity of both of these fascial structures with the fascial capsule of the bladder are

visible. The uterus and ovary have been reflected medially. The round ligament was running across the medial surface of the superior hypogastric wing. It was separated from it to permit the medial reflection of the body of the uterus. Also the suspensory ligament of the ovary with the ovarian vessels was running across the medial surface of the superior hypogastric wing. It had to be cut through in order that the ovary might be reflected medially. In the male the vas deferens takes a course similar to that of the round ligament of the female. When seen in the pelvis, after the peritoneum has been stripped off, the vas deferens appears to take an almost horizontal course from a point where it crosses the brim of the pelvis toward the ischial spine. As shown in Figure 6a, it is situated in this course upon the medial and superior surface of the superior hypogastric wing. In this illustration made for us by Professor Carl D. Clarke from the dissection of a white male by a narrow fascial mesentery upon which it can be freely moved against the superior

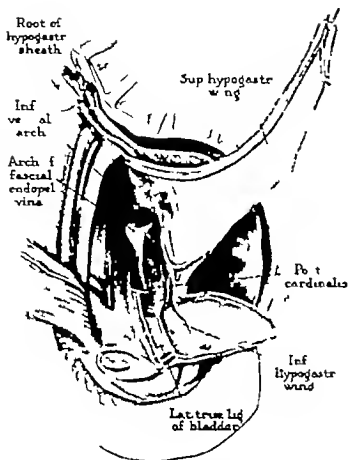


Fig. 4. Same dissection as in Figure 3, but promontory tilted slightly forward to permit full view upon floor and dorsal wall of lateral compartment of space of Retzius. Superior hypogastric wing cut away from lateral margin of bladder. Fascia endopelvina incised as far dorsally as ischial spine and arch of fascia endopelvina, to expose lateral true ligament of bladder and the portio cardinalis of levator ani.

hypogastric wing. This relationship is of importance. It means in the first place that the vas deferens descends nowhere to the level of the pelvic floor and secondly that it is strictly separated by the two fascial layers of the superior hypogastric wing and the structures enclosed between them from the space of the lateral compartment of the space of Retzius. In a similar manner the round ligament and the ovarian vessels of the female are separated from this space by the superior hypogastric wing.

By thrusting the hand into the lateral compartment of the space of Retzius and against the lateral side of the hypogastric root it was ascertained that the ridge No. 8 which we saw in Figure 1 was only the medial side of

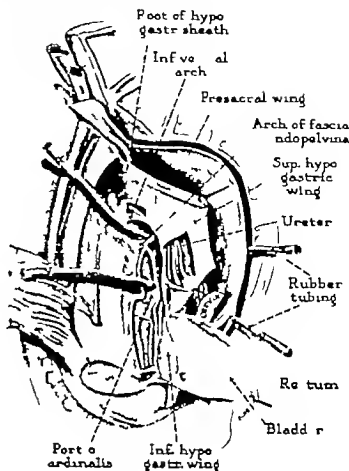


Fig. 5. Same dissection as in Figures 3 and 4, windows have now been cut into the lateral layer of the inferior vesical arch and inferior hypogastric wing. Through the former the inferior vesical vein is visible. In the latter the uterine vessels are exposed to view. Also it is seen that the vesical structures pass forward toward the bladder whereas the uterine vessels make an abrupt medial turn toward the uterus. The place where the uterine vessels turn medially represents the lateral root of Mackenrodt's ligament and lies at the same transverse level as the portio cardinalis of the levator ani. Body and fundus of uterus have been cut away. The fascia closing the space between the inferior vesical arch and the arch of the fascia endopelvina was incised and a piece of rubber tubing (x) was pushed through the incision. A similar piece of rubber tubing (y) was pushed through the floor of the lateral compartment of the space of Retzius, just dorsal to the portio cardinalis. Both tubes appeared in the retrorectal space, dorsal to the presacral wing and the rectum.

the root of the hypogastric sheath. The medial fascial layer of the hypogastric root was now carefully removed and cut away. Its cut edges are visible and the lateral layer which was seen upon inspection of the space of Retzius, is now seen from the medial side in the spaces between the vessels.

The contents of the hypogastric root are clearly seen. They consist of the anterior di-

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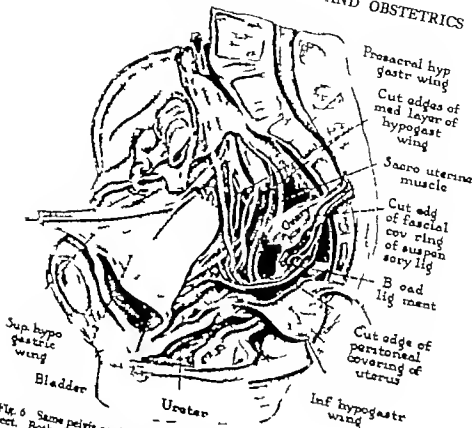


Fig. 6 Same pelvis as shown in Figures 3 to 5, but showing dissection of on medial aspect. Both the suspensory ligament of the ovary and the broad ligament have been cut in order to permit medial reflection of uterus and ovary. The genital stump of the suspensory ligament is seen attached to the ovary. The genital stump of broad ligament was left with the uterus. The superior hypogastric root and one of its superior vesical branches in the medial layer of fascia of the hypogastric wing is now seen from the hypogastric wing has been removed. In the former the ureter and the hypogastric vessels with their visceral branches are seen passing caudally. In the latter the ureter and vesical vessels are passing forward. The uterine vessels are seen turning medially to enter the Mackenrodt's portion of the broad ligament. The falciform portion of this ligament is seen as it connects the ovary with the uterus. It contains the anastomosis between uterine and ovarian vessels.

visions of the hypogastric vessels, of the visceral branches of these vessels, and of the ureter. The uterine and inferior vesical arteries arise separately. The rectouterine muscle corresponding to the sharp dorsal margin of ridge No. 8 in Figure 1 is seen as it had been dissected out of the fascia. All these structures pass nearly vertically from cranial to caudal. At a point corresponding to the place where upon inspection of the space of Retzius, we had seen the inferior vesical arch the vascular structures begin to take a forward course entering the inferior hypogastric wing the medial layer of which has been removed in

order to expose its contents. In this wing all the vesical branches and the ureter pass forward toward the bladder. Exactly the same situation is found in the male pelvis. Therefore no good reason to include anyone of these parts under the name of Mackenrodt's ligament. In particular it seems incorrect to count the entire hypogastric root as Curtis, Anson and Beaton (?) did as part of Mackenrodt's ligament, or to count the part of the inferior hypogastric wing immediately ventral to the ischial spine, as part of Macken-

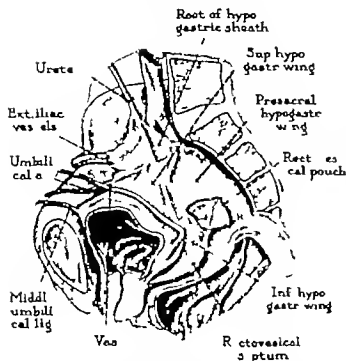


Fig 6a. Right half of pelvis of a white male (479-1945) aged 69 years. Peritoneum removed everywhere except for the rectovesical pouch and septum. The hypogastric sheath is seen in its entire extent. The vas deferens passes across the superomedial surface of the superior hypogastric wing and is thus excluded from the space of Retzius.

rod's ligament, as Peham and Amreich did. The beginning or root of Mackenrodt's ligament as a specifically female element, is clearly marked. It lies at the point where the uterine vessels are making a sharp medial turn branching away from the inferior hypogastric wing nearly at a right angle. Its distance ventral from the inferior vesical arch and ischial spine measured in the sagittal plane was 33 millimeters (more than 1 inch).

It becomes immediately obvious that the ischial spine and the relations existing there between the vessels and the coccygeus muscle as discussed previously, can serve only remotely by the intermediation of the inferior hypogastric wing as a means of uterine fixation.

In looking for structures which are specifically developed to counteract the medial pull of the cardinal ligament, we recollect now the portio cardinalis of the levator ani (Fig. 4) a series of fleshy and aponeurotic bundles inserted into the inferior hypogastric wing at exactly the place where the uterine vessels are branching off into the cardinal

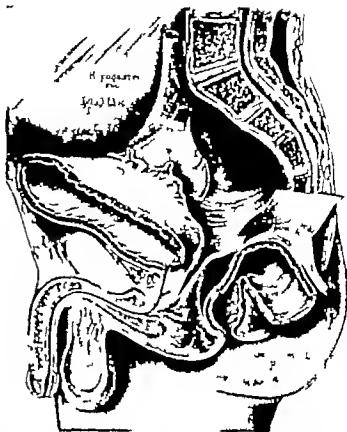


Fig 6b. Right half of pelvis of a white male of unknown age (479a, 1945). Peritoneum removed (except for the peritoneum of rectovesical pouch and septum) and elements of hypogastric sheath exposed to view. The vas deferens is seen running across superomedial surface of superior hypogastric wing, attached to it by a "fascial mesentery".

ligament. We observed that pulling on the cardinal ligament in a medial direction puts these fibers on tension. It is obvious that the specific function of the cardinal portion of the levator ani is that of fixing the root of the cardinal ligament to the pelvic floor. This interpretation agrees well with the fact that in the male the cardinal portion of the levator ani is absent.

In this connection it is interesting to speculate on the effects which the peculiar anatomical relation existing between ureter and uterine vessels at the point where these vessels turn medially may have upon the ureter. Throughout the largest part of their course the uterine vessels are running dorsal to the ureter. At the point where these vessels turn medially they pass first to the lateral side of the ureter and then hook around its ventral aspect. It is evident that by this arrangement the ureter being encased firmly between the two layers of the inferior hypogastric wing

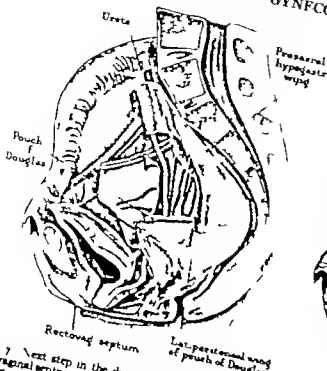


Fig. 7. Next step in the dissection shown in Figure 6. Rectovaginal septum dissected way from rectum. Septum and ectovaginal pouch (of Douglas) pulled forward to permit a lens into the preperineal space. Also the lateral peritoneal wing of the pouch and its attachments are visible.

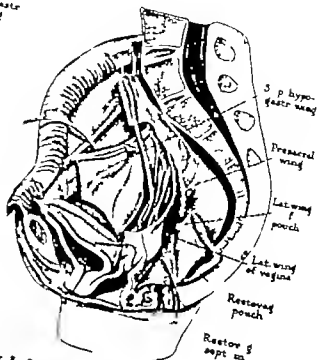


Fig. 8. Same dissection as in Figure 7 but rectovaginal septum has been dissected way from il of vagina. Septum and ectovaginal pouch pulled dorsally to permit a view into retrovaginal space. Also the ventral surface of the lateral fascial wing of the pouch and the dorsal surface of the lateral fascial wing of the vagina are visible. A ureteral catheter was introduced into an incision made in the lateral partment of the space of Retzius.

is made a counterpoise against the medial and downward drag exerted by the uterus upon the cardinal ligament thereby aiding in some measure the other structures which serve as these anatomical and mechanical relation ships it would appear probable that in the female certain conditions may arise where the uterine vessels are enabled to cause a strangu tor and muscle and the structures of the levator diaphragm surrounding the introitus, both of which are important components of the entire supporting system of the uterus, should fall owing to damages received for e during childbirth and the cardinal ligament alone is no longer able to prevent a dal dislocation of the uterus, it is conceiv e that the drag of the uterine artery may come so great as to produce a strangulation of the ureters which owing to their fixation within the inferior hypogastric wing would be unable to give way and thus relieve the pres-

sure exerted upon them by the uterine vessels. Ever since Tandler and Halban in 1907 (quoted by Bretttauer and Rubin) published their studies on prolapse of the uterus, it is known that hydroureter is a condition which is conspicuously often associated with pro lapse of the uterus. These findings were con firmed later on (In 1923) by Bretttauer and Rubin moreover these authors suggested actually that the cause of the frequent as sociation between these two disorders is the strangulation of the uterus by the drag of the uterine vessels. Unfortunately nobody seems to have furnished actual evidence in favor of this theory by dissection of suitable cases. Everett in his book on female urology quotes Bretttauer and Rubin but does not adduce any literature actually confirming the suggestion made by these authors. Should this theory however prove correct, it would furnish addi-

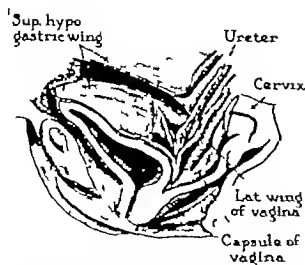


Fig. 9. Caudal portion of dissection shown in Figure 8 to show a further stage in this dissection. Capsule of vagina and its lateral expansion have been dissected away from the bladder and inferior hypogastric wing respectively. The inferior hypogastric wing with the ureter in it, is seen from a dorsomedial aspect, the lateral fascial wing of the bladder capsule presents its ventrolateral surface. The ventro vaginal space is exposed to view.

tional evidence to show that the ureter wing to its firm encasement between the two fascial leaves of the inferior hypogastric wing, and its peculiar anatomical relationship with the uterine vessels, does not easily yield and is capable of aiding under normal conditions of stress in mooring the uterus to the inferior hypogastric wing. Incidentally it would seem that in case of correctness of these assumptions, the strangulation of the ureter could be abolished by ligating and severing the uterine artery and relying on the ovarian artery for the blood supply of the uterus especially so as this latter artery plays the major rôle in the blood supply of the uterus after the first pregnancy.

On the basis of the evidence here presented we come to the conclusion that the lateral root of the cardinal ligament does not lie opposite the ischial spine but is located more than 1 inch ventral to the spine that in the female alone a structure the cardinal portion of the levator ani is developed and that the specific function of this structure is to moor the root of the Mackenrodt ligament to the pelvic floor and thereby give support to the uterus.

ATTACHMENTS OF RECTOVAGINAL SEPTUM

Since the rectovaginal septum and its attachments are the cause of a subdivision of the

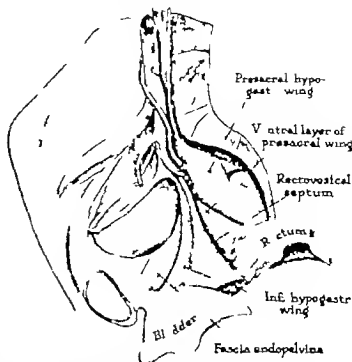


Fig. 10a. Right half of pelvis of white male (47941, 1945) of 60 years of age. Peritoneum removed to expose elements of hypogastric sheath. Hypogastric root has been dissected away. Superior hypogastric wing was cut away. Bladder was cut away from inferior hypogastric wing and pulled out of the pelvis. Rectum pulled medially. The lateral margins of the inferior hypogastric wing, the rectovaginal septum and the lateral fascial expansion of the rectal capsule are seen attached to the medial margin of the fascia endopelvina like the leaves of a book.

subperitoneal space of the pelvic cavity into a rectal and a genitourinary compartment it is appropriate that this subject be discussed here somewhat more in detail. The dissections which elucidate this point are illustrated in Figures 7 and 8.

With the aid of the fingers and a blunt instrument the rectovaginal septum was first separated from the rectum (Fig. 7) and then from the dorsal wall of the vagina (Fig. 8). In both instances it could be followed laterally beyond the lateral boundaries of the rectum and vagina to the medial margin of the fascia endopelvina, to which it was attached. At the same time a lateral wing of fascia arising from the capsule of the rectum and representing the caudal continuation of the presacral wing of the hypogastric sheath and a similar wing arising from the lateral margin of the vagina could be demonstrated the former is seen from its ventral aspect in Figure 7 as it extends laterally from the rectum the latter is

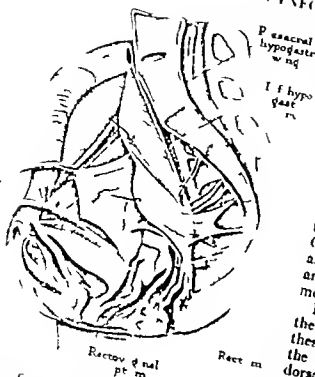


Fig. 9. Continuation of the dissection shown in Figure 8. The presacral hypogastric wing has been raised from the presacral fascia. It is seen as it covers the coccygeal muscle and has been reflected forward to permit view into the retrorectal space. This space is seen the autonomic nerves as they pass forward and laterally to enter the pelvic ganglion. The latter has not yet been dissected out. The sympathetic branches arise from the sympathetic ganglia, the other branches arise from the sympathetic plexuses of the sacral nerves. In the retrorectal space are seen also the rubber tubes which were pushed through the floor of the space of Retzius to show the relationship between this latter space and the retrorectal space.

seen from its dorsal aspect in Figure 8 as it rises to its fusion with the cardinal ligament. Both the rectal and the vaginal wing extended laterally toward the fascia endopelvis gain this attachment along the medial margin of the latter cranial and ventral to the line of attachment of the rectovaginal septum. In Figure 9 the ventrocranial surface of the vaginal wing is seen as it was displayed by dissecting it away from the inferior hypogastric wing which is illustrated with its medial leaf incised and reflected to show the structures that are contained in it (only the ureter has been illustrated).

From the description presented here it follows that the medial margin of the fascia endopelvis represents a line along which in the female four leaf like structures are attached from ventrocranial to dorsocaudal these are: (1) the inferior hypogastric wing of the bladder (2) the lateral fascial wing of the vaginal rectovaginal septum and (4) the lateral fascial wing (caudal continuation of presacral hypogastric wing) of the rectum. Upon this line of attachment the four leaf like structures can be turned like the leaves of a book. Grasping any one of the three pelvic viscera, after the dissection illustrated in Figures 7 & 9 had been finished, it could be freely moved back and forth upon its fascial wing. In the male pelvis owing to the absence of the vagina there are present only three of these leaves. They are illustrated in Figure 9a dorsally from the symphyseal pubis to the spine hypogastric wing the rectovesical septum and the ventral layer of the lateral fascial wing of the rectum.

Returning now to the rectovaginal septum it is seen in Figure 7 that it extended in this case as it did in many other subjects, far up cranially along the lateral margin of the rectovaginal pouch (in Figs. 7 and 8) forming a lateral wing by means of which the pouch gained a firm attachment to the presacral hypogastric wing lateral to the rectum and close to the origin of the presacral wing from the hypogastric root.

From this description it is obvious that owing to the presence of the rectovaginal septum and the nature of its attachments, the subperitoneal space of the pelvic cavity is divided into two strictly separated compartments a dorsal or rectal compartment and a ventral or vesicovaginal compartment. Similarly in the male, the rectovesical septum divides the subperitoneal portion of the cavity of the pelvis minor into a rectal and vesicoprostatic compartment.

THE FIVE FASCIAL SPACES OF THE PELVIC CAVITY
Altogether the subperitoneal space of the cavity of the female pelvis minor is subdivided

into five fascial spaces by four partitions three of these are represented by the three major pelvic viscera, their fascial capsules and the lateral fascial extensions of these capsules while one the rectovaginal septum is a fasciopentoneal sheet. In the male pelvis there are only four such fascial compartments

These fascial spaces are illustrated in Figures 3 7 8 9 and 10. They are from ventrocranial to dorsocaudal (1) the space of Retzius (lateral and ventral compartments) illustrated in Figure 3 (2) vesicovaginal space (Fig. 9) (3) retrovaginal space, between the vagina and the rectovaginal septum (Fig. 8) (4) prerectal space, between rectovaginal septum and rectum (Fig. 7) and (5) retrorectal space (Fig. 10) between the rectum and presacral hypogastric wing ventrally and parietal fascia dorsally

THE LATERAL COMPARTMENT OF THE SPACE OF RETZIUS

Of these five fascial compartments the space of Retzius is the most spacious and extensive one. Because of its easy extraperitoneal access by the suprapubic route and because of its important relationships the lateral compartment of the space of Retzius merits a special discussion of its boundaries and communications.

The lateral compartment of the space of Retzius may be said to have two side walls (a lateral and a medial wall) a floor and a roof and a dorsal wall. Ventrally it is in open communication with its partner of the opposite side via the ventral compartment of the space of Retzius. Dorsally it extends as far as the ischial spine.

Its lateral wall consists of the parietal endopelvic fasciae covering the pelvic surfaces of the internal obturator and of that portion of the levator ani which lies cranial to the white line (origin) of the fascia endopelvina. In this wall are located the entrance into the obturator canal the obturator vessels, and the obturator nerve.

The medial wall consists of the fascial capsule investing the inferolateral wall of the bladder and of the inferior wing of the hypogastric sheath and more dorsally of the forward extension of the hypogastric root. The

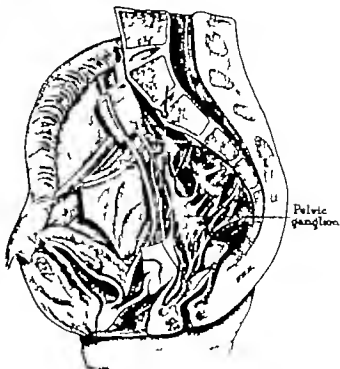


Fig. 11. A further step in the dissection shown in Figure 10. The ventral and dorsal layers of the presacral wing have been separated from one another to expose the pelvic ganglion which is enclosed in the space between the two layers.

inferior vesical vessels and their various branches, as well as the venous plexus of the bladder and the ureter are located in this wall. The inferior hypogastric wing separates the space from the vesicovaginal space (Fig. 9) when the beam of a flashlight is thrown into this latter space, it can be seen in the space of Retzius as it shines through the inferior hypogastric wing.

The floor of the space (Fig. 3) is made up by the fascia endopelvina differentiated in front into special vesical ligaments the medial and lateral pubovesical ligaments and the lateral true ligament of the bladder. It extends as far dorsally as the ischial spine and forms an investment of the aponeurotic fibers of the three ligaments and in the female hides from view the portio cardinalis (Fig. 4) of the levator ani. Cutting through this fascia between the ischial spine and the dorsal end of the cardinal portion creates access to the retrorectal space and the dorsum of the rectum. Also the autonomic pelvic nerves can be reached in this way (Fig. 10) as will be shown later on.

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The roof of the space is formed by the superior hypogastric ring (Fig 3) which contains the umbilical artery and its superior vesical branches (Fig 6). The roof excludes the round ligament of the uterus and the ovarian vessels in the female (Fig 6) and the ovary deferns in the male (Figs 6a and 6b) from the space of Retzius.

The dorsal wall of the space is formed by the hypogastric root (Figs 3 and 4) this contains the anterior division of the hypogastric vessels the visceral branches of these vessels and the ureter and seals the space off against the retrorectal space and the rectum. Caudally this wall ends in the easily palpable inferior vesical arch (Fig 4) which arises laterally from the ischial spine and conveys the inferior vesical vein and artery from and to the inferior hypogastric wing.

THE PELVIC GANGLION

The pelvic ganglion while it has received many excellent anatomical descriptions—the most recent one by Curtis, Anson Ashley and Jones (8)—and while it plays a major rôle in the control of the physiology of the pelvic viscera, is nevertheless seldom mentioned or considered in any way in descriptions of surgical procedures, an indication that our anatomical accounts of this structure do not yet lend them selves to the use by the practitioner. We have studied the topography of this anatomical entity from many different angles and in respect to several of the most frequent surgical procedures but are as yet unable to present this subject in a way easily applicable during the various pelvic operations. We have made several observations, however which will be recorded here.

In some subjects it is possible to display after removal of the loose connective tissue between the dorsal capsule of the rectum and the parietal fascia a special sheath the pararectal sheath which arises from the parafascia along a line corresponding to the anterior sacral foramina. This sheath contains between its two layers the pelvic autonomic nerves, conveying them to the presacral sheath with which it fuses. In the female cadaver described here only parts of such a sheath (Fig 10) could be displayed. After reflecting

the presacral sheath (Fig 10) forward, the individual nerves could be easily dissected. The inferior hypogastric nerve (see Curtis, Anson Ashley and Jones 8 for nomenclature), which was only loosely embedded in the dorsal leaf of the presacral sheath had been dissected out to the point where it received two branches from the second sacral sympathetic ganglion. Both the sympathetic and the parasympathetic branches are seen in Figure 10 as they pass, from their origins, laterally and toward the presacral sheath piercing the dorsal leaf of the sheath and entering the space between the two leaves of the sheath.

The further course of these nerves is shown in Figure 11. The presacral sheath was split into its dorsal and ventral leaves was split which succeeds easily if one begins with raising the ventral capsule of the rectum. The ventral leaf was carefully lifted away from the place where the presacral sheath arises from the hypogastric root. The peritoneum of the rectovaginal pouch (Fig 10) was also cut away as it obstructed the view of the illustrations of the nerves but the most caudal portion of the rectovaginal septum is still in place. By these manipulations the pelvic ganglion is exposed as it lies in the space between the two leaves of the presacral sheath close to where this sheath arises from the hypogastric root and where it is joined by the lateral extension of the rectovaginal septum.

The main extension of the ganglion, i. e. its longitudinal diameter is from cranial to caudal. A finger thrust laterally either into the prerectal (Fig 7) or retrovaginal (Fig 8) space would arrive just about at the caudal end of the ganglion. As it lies sandwiched between the two leaves of the presacral sheath medial to the hypogastric root it cannot be reached through the lateral compartment of the space of Retzius. If during a hysterectomy in the female or a cystectomy in the male the presacral sheath is left intact the pelvic ganglion will not be injured. If in making access to the retrorectal space from the lateral compartment of the space of Retzius (see the rubber tubes x and y in Figs. 5 and 10) the finger is pushed into the retrorectal space along the route indicated by the cranial tube x it

will be stopped by the sympathetic and parasympathetic nerves (or the pararectal sheath if that is present) to penetrate sufficiently far medially to reach the rectum the finger or the instrument must be given a caudal direction in order that it may slip through underneath these nerves (see Fig 10)

While the pelvic ganglion receives the hypogastric nerve at its cranial end and the sympathetic and parasympathetic branches at its dorsomedial margin it gives rise to the branches of distribution at its ventrolateral margin and at its caudal end. We have not followed these branches to their terminations. The origins of many of them are seen however in Figure 11 they are joined in their course by a direct branch from the inferior hypogastric nerve. Thus as well as the ventral branches of the ganglion pass into the inferior hypogastric wing evidently to be distributed to the uterus, vagina and bladder. From the caudal end of the ganglion two stout nerves took origin which were seen passing caudally between the rectal musculature and the ventral capsule of the rectum. An arrangement very similar to the one described here was found in several male cadavers.

SUMMARY

1 In the dissection of the pelvis of an adult female supplemented by the dissection of several other pelvis the following components of the visceral endopelvic fascia were studied (a) the hypogastric sheath (b) the fascia endopelvina, (c) the cardinal ligament

2 From the hypogastric root three fascial wings a presacral an inferior and a superior wing take origin. Each of these represents a well defined and easily demonstrable double layered fascial membrane of considerable firmness

3 The presacral wing is associated with the rectum the superior and inferior wings with the bladder

4 The presacral wing absorbs the superior hemorrhoidal sheath furnishes the capsule of the rectum contains the pelvic ganglion between its two layers and in combination with the hypogastric root seals the retrorrectal space off against the lateral compartment of the space of Retzius

5 The superior hypogastric wing constitutes the roof of the lateral compartment of the space of Retzius conveys the superior vesical arteries to the bladder and excludes the vas deferens round ligament of the uterus ovaries and ovarian vessels from the space of Retzius.

6 The inferior hypogastric wing represents one of the major anchorages of the bladder. It conveys the inferior vesical vessels and the ureter

7 Opposite the ischial spine the inferior hypogastric wing is firmly attached to the pelvic wall by the inferior vesical arch through which the inferior vesical vessels are passing on their way between the root and the inferior wing of the hypogastric sheath. Through the inferior vesical arch the bladder is moored to the pelvic wall in the region of the ischial spine.

8 The cardinal ligament arises from the medial side of the inferior hypogastric wing located at a point which is situated more than an inch ventral to the ischial spine. The place where the cardinal ligament is moored laterally to the pelvic floor does not lie opposite the ischial spine but more than an inch ventral to it where the fleshy and aponeurotic fibers of the portio cardinalis a part of the levator ani especially differentiated for that purpose in the female pass from lateral to medial into the inferior hypogastric wing

9 The fascia endopelvina (together with its ventral differentiations the medial and lateral pubovesical ligaments and the lateral true ligament of the bladder) is attached laterally to the pelvic floor along the white line of the fascia endopelvina. To its medial margin are attached like the leaves of a book four (three in the male) leaflike structures the inferior hypogastric wing the lateral fascial wing of the vagina the rectogenital septum and the lateral wing (caudal portion of presacral sheath) of the rectum

10 The lateral compartment of the space of Retzius does not extend as far dorsally as the rectum. At the level of the ischial spine it is sealed off against the rectum by the root of the hypogastric sheath

11 Through the floor of the lateral compartment of the space of Retzius subperitoneal access can be created to the rectum

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12 The rectogenital septum by its attachments laterally to the fascia endopelvina and presacral wing partitions off the subperitoneal space of the pelvis minor into two compartments a rectal and a urogenital

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THE HETEROLOGOUS GROWTH OF CANCER OF THE HUMAN PROSTATE

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THE growth of human cancer in an alien host offers an experimental approach to the study of the biological activity of malignant tissue. Human prostatic cancer in particular presents a type of malignant growth which may be investigated from the point of view not only of autonomous growth but also of endocrine factors. Previous experimental work on prostatic cancer has been limited to three methods of investigation tissue culture *in vitro* the effect of hormones on the prostatic gland of animals and the stimulation with chemical carcinogens of susceptible strains of laboratory animals. Each of these methods has added knowledge but the secret of causation and the cure of prostatic cancer have not yet been discovered. The object of this paper is to present for the first time the results of heterologous transplantation of carcinoma of the human prostate. This research also includes observations on the effect of hormone stimulation and the biologic activity of the enzyme acid phosphatase in animals with human prostatic cancer growing in the anterior chamber of the eye.

The tissue culture phase of the experimental work was stimulated by the demonstration in 1907 by Ross G Harrison that normal frog tissues and cells could be cultivated outside the organism. Three years later Carrel and Burrows (3) using a modified and improved method of tissue culture, first observed the growth of human cancer cells *in vitro*. In 1917 Burrows, Burns and Suzuki (1) cultured tissues from cancers of the human bladder and prostate and studied the biologic changes which take place in cells outside the body.

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Burrows and Kennaway (2) attempted to produce cancer of the prostate in mice by the use of hormones. They observed that long continued estrogen injection caused squamous metaplasia of the prostatic epithelium but no true adenocarcinoma of the gland resulted. Van Wagenen noted fibromuscular hyperplasia in the stroma of the prostate of macaque monkeys as the result of stimulation with large doses of estrin. Moore (8) reviewed the experimental problem of the production of cancer of the prostatic gland by hormones and concluded that in no instance had true adenocarcinoma resulted after the administration of either androgen or estrogen.

Working with the carcinogen benzpyrene Moore and Melchionni (9) caused squamous metaplasia of the prostate in rats after the injection of the chemical into the gland. Dunning, Curtiss and Segaloff induced squamous cell cancer of the prostate in two inbred strains of rats by injection of methylcholanthrene into the prostatic gland and found that these cancers when transplanted to the subcutaneous tissues metastasized to the lungs and skeletal system.

In 1935, Heckel and Kretschmer transplanted homologously normal rabbit prostate into the anterior chamber of the eye stimulated the transplants with pituitary like hormones and obtained growth of the prostatic transplant. More recently the successful heterologous transplantation of human cancers into the anterior chamber of the eye of alien hosts by Greene suggested a new experimental approach to the cancer problem.

MATERIALS AND METHODS

Guinea pigs were employed as the alien hosts in this investigation and the specimen for transplantation was inoculated into the anterior chamber of the eye under sterile precautions. A frozen section of the original



Fig. 2

Section of human adenocarcinoma of the prostate gland. Note large cuboidal cells invading the stroma. $\times 75$

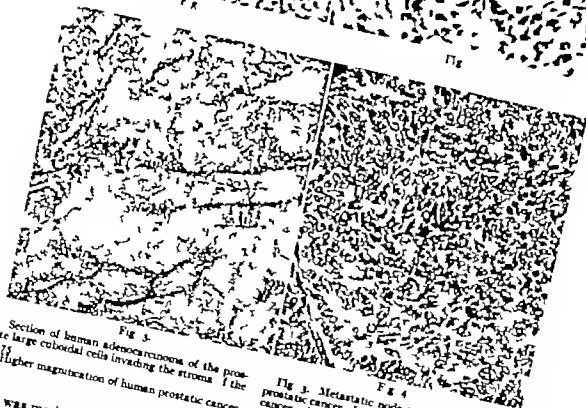


Fig. 3

Higher magnification of human prostatic cancer. $\times 300$

Fig. 3. Metastatic node to left vas deferens of human prostatic cancer. Lesion is characterized by solidly packed cancer cells, atypical in structure with very little stroma. Portion of this tissue used for heterologous transfer. $\times 75$

Fig. 4

Fig. 4. Higher magnification of metastatic lesion. $\times 300$

specimen was made before transfer to identify the tissue as a true cancer and to allow the experimenter to choose areas bearing relatively more cancer cells for transfer. The technique of an anterior chamber transplant was

easily carried out. Using surgical precautions, the eye of the animal was anesthetized with a drop of 5 per cent cocaine and the anterior chamber was opened at the corneoscleral junction by a quick stab with a corneal knife. A



Fig 5.



Fig 6



Fig 7



Fig 8



Fig 9.

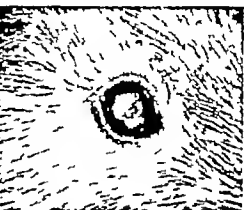


Fig 10

Fig 5. Photograph of guinea pig (male) with anterior chamber transplant of human metastatic prostatic cancer after 22 days' growth.

Fig 6. Second generation transplant (male) after 18 days. Note marked vascularity of growth. Chamber is half filled with tumor.

Fig 7. Third generation transplant (male) after 20 days growth.

Fig 8. Fourth generation transplant (male) after 21 days' growth.

Fig 9. Fifth generation transplant (male) after 22 days growth.

Fig 10. Fifth generation transplant (female) of prostatic cancer after 20 days growth. Animal has been stimulated daily for a period of 35 days with 5 milligrams testosterone.

small fragment of tissue measuring about 0.5 millimeter in diameter was then introduced into the anterior chamber by means of a trocar. The tissue was guided to the lower angle of the iris by a blunt instrument. No further care was necessary and the corneal incision healed rapidly.

CASE HISTORY

The tissue used in this heterologous transfer was removed from a metastatic lesion of cancer of the prostate involving the left vas deferens. In July, 1945 the patient, a 69 year old lawyer, was admitted to the hospital because of progressive diminution in size and force of the urinary stream. The family history was significant in that the patient's father had died at the age of 55 of cancer of the throat. The rectal examination was characteristic of an extensive malignant prostatic lesion. There had been no weight loss, nor was there any evidence by x ray of

bone metastases. Serum acid phosphatase was 6.95 King Armstrong units.

Since the prostatic lesion was too extensive for total resection it was decided to establish a histological diagnosis and then to treat the patient by means of estrogen therapy. Perineal biopsy revealed an adenocarcinoma of the prostate gland characterized by irregularly growing sheets and strands of cuboidal cells invading the connective tissue (Figs 1 and 2).

The patient tolerated estrogen badly and although he was on a dosage of 1 milligram daily took it irregularly during the year lost weight and was generally unhappy. He did not develop any metastatic pain for 9 months. In May, 1946, 10 months after he was first seen a metastatic x ray series revealed extensive bony metastases involving the lumbar and sacral regions. A cystic mass the size of an egg had developed in the region of the left vas 3 centimeters above the testis. Serum acid phosphatase at that time was 4.2 King Armstrong units. The patient consented to castration and the removal

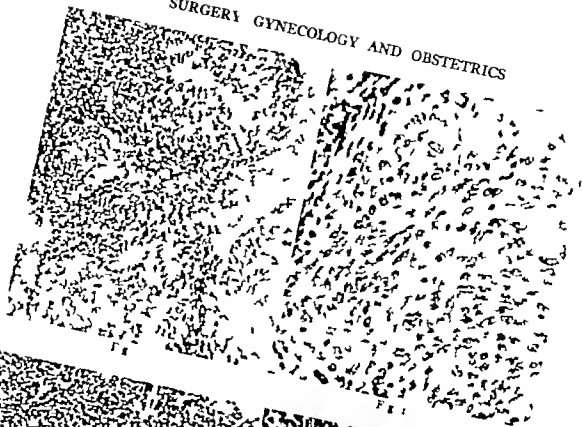


Fig. 13.

Fig. 13. Section of anterior chamber growth of human prostatic cancer: first generation. Adenoid nature of transplant is maintained. $\times 45$.

Fig. 14. Higher magnification of first generation growth. $\times 300$.

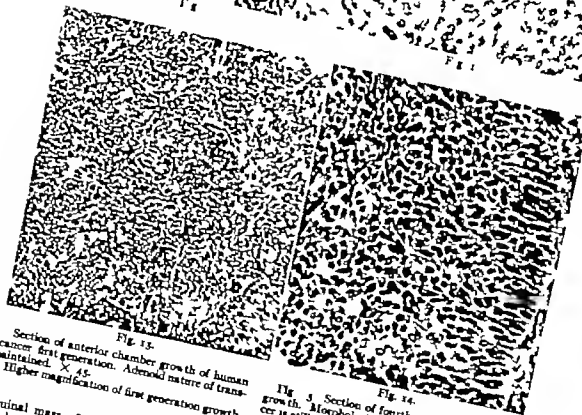


Fig. 14.

Fig. 13. Section of fourth generation: anterior chamber growth. Morphological similarity to original human cancer is still apparent. $\times 145$.

Fig. 14. Magnification of fourth generation growth. $\times 300$.

of the inguinal mass. This tumor proved to be a metastatic lesion from the prostate. It was composed of cells arranged in gland-like formation, with hyperchromatic nuclei, pink-staining cytoplasm, and many mitotic figures. A portion was utilized for ca pig transfer (Figs. 3 and 4).

Castration did not relieve the patient of his back pain, but when the estrogen dosage was raised to 15 milligrams daily the pain disappeared. At the present time this dosage is still being administered to the patient and he seems to be in fairly comfortable condition.

TABLE I.—RESULTS OF HETEROLOGOUS TRANSPLANTATION OF HUMAN PROSTATIC CANCER INTO THE EYES OF GUINEA PIGS

Generation	Number of pigs		Number of takes		Takes per cent	
	Male	Female	Male	Female	Male	Female
First	7	5	5	1-*	71.4	
Second	6	4	2	1-*	25-	
Third		5	8	0	16.6	
Fourth					33.3	
Fifth	6	0			14	100-
Sixth	7	1†		†	47	6
Totals	68	16	30			

*Initially "takes" but within 10 days regressed.
 †Received 5 mgm. testosterone daily for 35 days starting with the day of transfer

These details are presented to show the course of a vigorously growing prostatic malignancy

RESULTS

The first transfer was made on August 13 1946 at which time 12 guinea pigs were inoculated 7 male and 5 female. The usual course of an anterior chamber transfer ensued. The primary period of foreign body reaction was followed by a clearing of the chamber in 6 to 7 days and then rapid vascularization of the transplanted tumor. In 2 to 3 weeks growth was usually evidenced by increase in size and the presence of healthy pink coloration of the new tissue growth. On the average the latent period between transfer and growth was 15 to 20 days although the period became successively shorter in later generations. When the eye was half or more filled with tumor growth the animal was sacrificed and part of the transplant was transferred to another generation of animals. In 6 serial generations of transfer a total of 84 animals were used 68 male and 16 female. Throughout all the generations the transfer the cellular morphology seen in the parent human tumor was maintained. The stroma of the transfer represented the result of the guinea pig reaction to a foreign tissue but the actual cancer cells were a reproduction of the original human tumor cells. These cells reproduced the tumor histologically but biologically differed in that there was a recession of production of acid phosphatase enzyme (Figs. 11 12 13, and 14)

TABLE II.—RESULTS OF HORMONE STIMULATION AND CASTRATION OF GUINEA PIGS WITH TRANSPLANTED HUMAN PROSTATIC CANCER

Generation	Number of pigs		Testosterone stimulated		Controls		Castration		Takes after castration	
	M	F	M	F	M	F	M	F	M	F
Third	3	5	4*		4					
Fourth	0			2*						
Fifth	6			2						
Sixth	7		2*	1			4			
Totals			6	3	4					

*Stimulation with 5 mgm. testosterone daily for 30 days with equal local results.
 †Stimulation with 5 mgm. testosterone daily for 35 days.

The results of serial transfers to the anterior chamber of the guinea pig are shown in Table I

A Hormonal factors During the first two serial generations of heterologous transfer natural growth was allowed to take place. Beginning with the third generation castration and androgen stimulation were added to the experiment. These results are summarized in Table II. Successful "takes" occurred in 33 animals, slightly less than one-half but only 1 of these "takes" occurred in a female animal. This female guinea pig was stimulated with a tremendous dosage of testosterone 5 milligrams daily for 35 days starting with the day of transfer.

Of 8 animals with successful takes in the third generation 4 were stimulated with testosterone 1 milligram daily for 30 days but no particular increase in rate of growth occurred as compared with 4 animals with successful "takes" used as controls. The eye filled up one-half to full in these cases, but the controls grew just as fast, and no definite conclusions could be drawn as to the positive effect of testosterone. Examination of microscopic sections of the testes of the animals stimulated with androgen did not show any changes. Two male animals in each of the fourth and sixth generations were castrated prior to transfer of the tumor. None of these male castrated developed successful takes from the transplanted tumor. In 15 female guinea pigs inoculated with human prostatic cancer not 1 animal developed a successful "take". When

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TABLE III.—PHOSPHATASE LEVELS OF GUINEA PIGS WITH AND WITHOUT PROSTATIC CANCER GROWING IN THE ANTERIOR CHAMBER OF THE EYE (KING-ARMSTRONG UNITS)

Pig Number	Tumor-bearing animals			Controls	
	Generation	Acid phosphatase	Alkaline phosphatase	Acid phosphatase	Alkaline phosphatase
3	First	8		14	8
4					
5	Second	9	8	8	5
6				7.3	8
7					
8				10.9	18.7
9	Third	6	6.7	4	3
10	Fourth	14.5	18.7		
11					
12				7.9	8
13				10.4	10.8
14				9.1	4.4

testosterone in massive doses 5 milligrams daily for 35 days starting with the day of transfer was given a successful take did occur in a female guinea pig. Microscopic examination of the endocrine organs of this animal did not reveal any marked cellular changes. The ovaries had formed follicles and corpora lutea, and the pituitary and adrenals appeared normal.

The fact that the prostatic tumor did not grow in female animals and could not be transferred to castrated males took on a significant meaning since previous attempts to transfer a metastatic node from a proved case of carcinoma of the prostate had failed, although transplants seemed to remain alive for some time. On reconsidering these facts it was deduced that all the animals used in this previous unsuccessful transfer were females.

B. Enzyme factors. Serum acid phosphatase levels were determined in normal guinea pigs and those having prostatic cancer transplants growing in the anterior chamber. This technique was easily performed by anesthetizing the animals and performing cardiac paracentesis. The heart blood was then measured

for the presence of phosphatase in King-Armstrong units. The blood phosphatases for normal and tumor bearing animals did not differ as shown in Table III.

The serum acid phosphatase level of guinea pigs was not affected by the presence of human prostatic cancer growing in the anterior chamber of the eye. The results obtained from both normal and tumor bearing animals varied greatly but no marked difference resulted from heterologous transplantation. Phosphatase stains on sections of transplants in the fourth and sixth generations failed to show the presence of enzyme. The regression of prostatic acid phosphatase enzyme in heterologously transplanted human prostatic cancer as shown by negative phosphatase staining reaction corroborated the finding of absence of elevation of blood serum acid phosphatase reading in tumor bearing animals. The transplanted cancer therefore must have undergone a change in biological activity in the guinea pig although the morphological structure of the tumor remained the same as the original human cancer.

An attempt was made to determine whether the enzyme acid phosphatase was produced by the cellular nucleus or cytoplasm. Human benign and malignant prostatic tissue was first emulsified in a Ten Brock homogenizer and then centrifuged at high speeds to isolate the cell nucleus from the cytoplasm. These constituents were then stained for phosphatase content. The amorphous cytoplasm of centrifuged prostatic cellular material gave a much heavier stain for phosphatase than did the nuclear portion of the cell, indicating that the greater part of the enzyme acid phosphatase was a component of the cytoplasm of the prostatic cell.

COMMENT

The growth of human prostatic cancer in an alien host proves conclusively that this cancer is an autonomous growth. The results of heterologous transplantation of human prostatic cancer using the guinea pig as the alien host have indicated that this cancer is influenced by hormonal factors within the animal. Lack of growth of transplanted prostatic cancer in female animals implies that the male hormone must be present for the growth of this tumor.

Similarly, human clinical experiences have revealed that cancer of the prostate has not been found in eunuchs. No cellular changes were found in the testes of guinea pigs stimulated with testosterone. The endocrine system of a female guinea pig stimulated with massive doses of androgen did not show any cellular changes. Testosterone or one of its constituents therefore, must be present for the growth of prostatic cancer in male animals, but this experimental study suggests that the actual amount of the substance is not important, since control animals grew tumors just as rapidly as testosterone stimulated males.

The inherent ability of prostatic cancer cells to produce the enzyme acid phosphatase disappeared on heterologous transfer. The absence of the enzyme activity in tumor growing in the guinea pig eye was corroborated by the finding of no elevation of blood phosphatase levels and by the results of tissue stains. The enzyme acid phosphatase is a product of cellular metabolism and is produced by both nucleus and cytoplasm. Although the enzyme activity of the prostatic cell changed on heterologous transfer the transplanted tumor retained its autonomy and was transferable to succeeding generations. One can therefore postulate that the all important part of the cell in malignant growth is the nucleus. It is the cellular nucleus then, which is the portion of the malignant cell that does not alter its character but keeps on growing wildly in spite of the alien host or environment. This cellular nucleus must hold the key to the answer why malignant cells set up an autonomy and characteristic trait of disordered, uncontrolled cellular growth and metabolism.

Heterologous transplantation presents a method of investigation of human cancers to elicit the effects of biologic agents, carcinogens, hormones and perhaps even cancer lytic substances upon malignant growth.

CONCLUSIONS AND SUMMARY

- 1 Cancer of the prostate gland has been successfully transplanted heterologously in

guinea pigs for the first time demonstrating the autonomous nature of this cancer.

- 2 By serial transplantation of this malignant tumor it has been shown that prostatic cancer is under the influence of endocrine factors.

- 3 When transplanted heterologously in male castrated guinea pigs, human cancer of the prostate did not grow. Similarly in human clinical observation cancer of the prostate has not been found in eunuchs.

- 4 Stimulation of female guinea pigs with small amounts of androgen did not affect the growth of transplanted prostatic tumor but stimulation of a female with massive doses aided in establishing a successful take of prostatic cancer.

- 5 Carcinoma of the human prostate heterologously transplanted in guinea pigs lost a fundamental biological activity, the production of the enzyme acid phosphatase. This fact was demonstrated by the absence of elevation of blood phosphatase level in tumor-bearing animals and absence of stain for phosphatase in sections of tissue removed from the guinea pig eye.

- 6 Heterologous transplantation of human prostatic cancer has indicated that the cellular nucleus holds the key to the biological activity of malignant cells which have become autonomous, disordered in growth and uncontrollable in cellular metabolism.

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STUDY OF URETERAL BLOOD SUPPLY AND ITS BEARING ON NECROSIS OF THE URETER FOLLOWING THE WERTHEIM OPERATION

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THE radical, or Wertheim operation for carcinoma of the cervix uteri occasionally results in serious damage to the ureter, necrosis and fistula formation occurring in 6 to 10 per cent of cases (15 57 23). Meigs (33) the champion of the Wertheim operation reported 12.3 per cent spontaneous ureteral fistulas, in his last series published. However, this figure has been sharply reduced in most recent cases in which he carefully avoided injury to the major ureteral vessels. Such operative mortality and morbidity but has often necessitated nephrectomy or other surgical procedures which in themselves may be serious. Anspach in reviewing the problem of cancer of the cervix since the introduction of radium therapy in 1912 predicts that despite the great improvement in results from surgery the morbidity from ureteral injury will still remain. Lynch (25) remarks that the radical operation is justifiable when it can be done not only with little or no mortality but with the avoidance of fistula and other major morbidity. Meigs (32 33) in spite of his zero mortality rate thinks the greatest drawback to the operation is ureteral injury and insists that its incidence must be lowered. Most authors have reported that this complication is primarily brought about by an interference with the blood supply of the ureter incurred during the operation. Meigs (33) in his most recent report on the Wertheim operation states that with better understanding of the ureteral blood supply fewer ureteral fistulas would develop. It is hoped that a study of the ureteral blood supply may bring to light some facts which may aid in reducing this serious complication.

It seems pertinent that a brief account of the genesis of the Wertheim operation and a review of the more recent literature concerning it be included in this discussion.

In 1878 Freund operated by the abdominal route on a patient who had carcinoma of the cervix. His procedure became the basis for all successful operative methods for this malady. In 1895 Clark, Ries and Rumpf suggested a more radical procedure which included removal of the pelvic lymph nodes. Wertheim's extensive series is credited with popularizing the operation which since has been known as the Wertheim operation. This operation consists of the removal through the abdominal route of the uterus and adnexa and by the use of clamps as much of the vagina as possible. The ureters are dissected and freed bilaterally to enable the operator to remove as much parametrium as feasible and finally to extirpate all enlarged pelvic lymph nodes. It is during the dissection and freeing of the ureters along their courses through the parametrium that injury in one form or another may occur. Since this study is limited to necrosis and fistula formation as a result of injury to the blood supply of the ureter those injuries due to cutting clamping or ligating the ureter will merely be mentioned although Bland Fenner and Adams have shown that all types of injuries to the ureter are very frequent complications of this type of operation.

Until recently in this country the mention of the Wertheim operation brought forth strong protest from the majority who are called to treat carcinoma of the cervix. Many have considered and some still hold that the percentage of cure resulting from this formidable operation is not high enough to

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compensate for the inherent high mortality and morbidity rate. Henry Schmitz, once wrote "If Shakespeare were alive today he might have written 'The evils of carcinoma operations live after them the good is oft interred with their bones'."

Meigs (32, 33, 34) dissatisfied with the results obtained after radiation therapy became interested in Taussig's work (51, 52, 53) on iliac lymph adenectomy combined with radiation. He decided to employ radical surgery in selected cases, in the form of the Wertheim technique, utilizing Taussig's method of lymph node dissection. His rationale is based on six points: (1) If the cervix has been removed there is no chance of a recurrence in it. (2) If the cervix has been removed no cervical cancer can regrow in it as a recurrence. (3) Cervical cancers of the cervix are radioresistant. (4) There will be less damage to the bowel if surgery is undertaken. (5) Patients with lymph node metastases can be cured by surgery in some instances. (He does not believe it possible to cure by means of radiation metastases in lymph nodes deep in the pelvis.) (6) With the cervix removed it cannot become the nidus of a recurrence or a new tumor.

Buske and Cantrell report that 20 per cent of stage I and 30 per cent of stage II cases are not cured by even the most competent and skilled radiotherapist but they suggest that possibly these figures may be reduced by improvement of radiation therapy. These authors state that "Granted that irradiation therapy cannot sterilize lymph node metastases, Meigs has saved 9 cases. However in accomplishing this, 20 patients have had to have Wertheim operation to save 3 that could not be saved otherwise. Meigs (35) has performed 100 Wertheim operations without a single operative death. His mortality rate is the lowest ever reported for this procedure and is a far cry from the high primary mortality rate that one finds reported in the earlier accounts. According to Martzloff there is a third era probably at hand, a period of a more rational employment of surgery or irradiation or both, to serve until such time as some more fundamental solution of carcinoma treatment is developed. Martzloff's statement is supported by a survey of the recent literature."

Counsellor reports that the Mayo group has done a total of 113 Wertheim operations in the last 10 years, with results approximating those of Meigs. They feel that the Wertheim procedure should be given consideration in selected cases. McMurray believes that the entire armamentarium available for therapy must be utilized and that there are definite indications for x ray, radium, and surgery. Morton (37) reports 100 cases of carcinoma of the cervix treated surgically by the Wertheim technique with over all primary mortality of 6 per cent. Of these cases 78 patients were operated on in the last 20 years with a mortality of 2.7 per cent (a rate lower than in total services which include the earlier operations). He (38), also does a pelvic lymph adenectomy along lines set forth by Taussig (51). Lynch (26, 27) and Taussig (53) advocate the Wertheim operation in early cases. Weaver (54) subdividing Group I of the League of Nations combined with Martzloff's or Broder's cellular classification, recommends a combination of surgery, x ray, and radium in these early cases. Bonney (4) Goodwin Schlink and Chapman and Maguire, all of the British Empire, are among the current proponents of surgical treatment.

It is apparent that many surgeons are cautiously returning to surgical therapy either alone or in combination with radiation. This we believe is the result of two factors: (1) The mortality rate has now approached a figure compatible with the operation's continued use. This has been the result of proper and careful selection of cases for surgery improved surgical technique, better anesthesia, the use of preoperative radiation to sterilize the cervix, transfusions of whole blood and plasma and the sulfa drugs and the antibiotics. (2) A desire to better the current percentage of salvages by utilizing every available means of treatment.

Skinner sums the whole problem of treatment of cervical carcinoma as it stands today by stating that "we now enter into a desperately competitive era of research, pathological studies, irradiation, surgical liberties, tempered only by mortality, morbidity statistics, impeded by unpleasant hospitalization, and most anesthesia progress."

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important, a public response to lay education and increasing support to lay activity

ETIOLOGY OF SPONTANEOUS URETERAL FISTULAS FOLLOWING THE WERTHEIM OPERATION

Concerning the etiology of spontaneous fistulas following the Wertheim operation one may note that these have occurred in practically every series reported. Wertheim felt sure that they were due to a disturbance of the blood supply of the ureter leading to a subsequent necrosis of that organ. Weibel noted that these fistulas occur in the easy operations as well as in the difficult ones where extensive isolation of the ureter must be carried out. Since these fistulas appear at the place where the ureter runs through the parametrium, he postulates that this constitutes a *locus minoris resistentiae*.

The majority of reports indicate that, as Wertheim postulated, the main factor is a disturbance of the blood supply of the ureter. However not all authors are of this opinion. Frommolt (14) believing the vascular anastomosis of the ureter to be so efficient that injury of its blood supply is of no great moment, blamed necrosis and subsequent fistula formation on direct injury to the ureteral wall. Weibel believed that there may be several factors at work ligatures too near the ureter held that postoperative kinks of the ureter are more important than injury of the blood supply. Some German authors felt that if necrosis were due solely to a destruction of the blood supply to the ureter the incidence of necrosis and fistula formation should be very high because most surgeons stripped the ureter of its incoming blood supply for great distances. Fitel, at Wertheim's request, studied the upper part of the ureter and showed that the medial side from the aorta, common iliac, and internal iliac arteries. The lower part was supplied by vessels lateral to the ureter i.e. uterine and vesical arteries. He therefore deduced that to avoid injury to these vessels when exploring the pelvic ureter the perineum above should be incised laterally the incision being carried down on the medial side of the ureter. Sampson (44) noted that al-

though Wertheim following Fitel's suggestion was apparently preventing necrosis by the method of incision, by remaining medial to the ureter he also ran the risk of leaving carcinoma parametrium behind.

Sampson (44) following injection studies of the ureteral vessels in cadavers and experimental studies on dogs came to the conclusion that the protection of the periureteral sheath and its enclosed periureteral vascular anastomosis was of more importance than was the avoidance of injury to the main vessels themselves. We believe that Sampson and Fitel were both correct in that it is of the utmost importance to preserve both the periureteral plexus of vessels and the ureteral artery themselves and in particular the main artery of the ureter the less the chance for necrosis whether the ureteral wall has been injured or not. There may well be accessory etiological factors which play a part in certain cases, but such instances are believed to be in a minority. Sampson (45) considers the following factors as possibilities in addition to injury to the periureteral sheath and its vascular plexus: (a) ligation of vessels supplying the formation of adhesions which splint the ureter (exudates, gauze packs, infection cauterization of the ureteral tissue bed, or mass ligatures (c) pressure on the ureter (d) stricture below ureteral injury (e) general lowered resistance of the patient.

THE BLOOD SUPPLY OF THE HUMAN URETER AND ITS RELATION TO URETERAL FISTULAS

Anatomical texts (10 17 46) mention the blood supply of the human ureter in one or two brief sentences. A. V. Haller was the first to give an adequate description of the ureteral blood supply. He recognized that the upper third of the ureter was supplied by the renal artery the middle third had an artery of its own and the lower third received branches from the vesical arteries and the uterine arteries. A review of the literature (12 15 19 40 42 44) reveals that there have been but few who have studied this subject in any detail. When the present study was undertaken it was thought that ordinary dissection of the

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TABLE I—ORIGIN OF URETERAL ARTERIES AS FOUND IN DISSECTION OF THE URETERS IN SEVEN STILLBORN INFANTS

	Subject	Renal artery	Internal spermatic (ovarian) artery	Abdominal aorta	Common iliac artery	Hypogastric artery	Uterine artery	Superior vesical artery	Middle vesical artery	Inferior vesical artery	Middle mesonephros-duct artery
M.	Right ureter		x			x	—	o		x	o
	Left ureter						x		o	x	
F.	Right ureter			x	x	o	—				
	Left ureter	x	x				—				
M.	Right ureter		o				—			x	
	Left ureter	x					—		o		
M.	Right ureter		(accessory)				—				
	Left ureter				x	x	—	o		x	x
M.	Right ureter					o	—				
	Left ureter	x			x		—	o		x	
M.	Right ureter	x					—				
	Left ureter	x			x	o	—			x	
M.	Right ureter					x					
	Left ureter	x			x	x					
M.	Right ureter										
	Left ureter		o							x	

From the above chart one may conclude that the main blood supply to the ureter may be multiple; their source being either the abdominal aorta, common iliac, or hypogastric arteries or, combination of these. The main blood supply may thereby be endangered in freeing the ureter through its pelvic course or during pelvic lymphadenectomy. The ureteral branches from the renal, uterine and vesical arteries are constant but short local branches. These, however, play an important part in the peritoneal anastomosis. Ureteral branches from the internal spermatic (ovarian) arteries are inconstant and are generally small twigs.

cadaver would supply the needed information. However, difficulties were encountered in exposing the minute vessels, and after dissecting several adult subjects this was abandoned. It was then decided to work on fresh stillborns using an injection mass to facilitate identification and dissection of blood vessels. Since colored synthetic liquid latex has been used to study the blood supply of various organs and tissues with great success it¹ was chosen for this study. As shown by Lieb (24) the substance penetrates even the smallest vessels. Such injected preparations lend themselves to corrosion and clearing.

The apparatus used for perfusion was a simple one patterned after that described by Narat, Loef and Narat consisting of two pressure bottles with a mercury manometer hooked in by means of a Y tube to allow for pressure readings. Perfusion of the specimens was carried out through the descending thoracic aorta, tap water being used at 50 millimeters of mercury for 1 hour then 100 to 120 millimeters from 4 to 6 hours. After difficulty

was experienced with leaks in the vascular system in the first two specimens the abdominal cavity was subsequently left unopened except for a small slit in the left lower abdominal quadrant. This not only acted as an escape for the intraperitoneal accumulation of fluid but also allowed a small segment of the small intestine to be drawn out and observed during the injection of the liquid latex thus noting the progress of arterial filling. During perfusion the specimen became notably swollen but after having been placed in a refrigerator overnight the edema practically disappeared.

A small compressor motor was used to inject the mass, at a pressure of 120 millimeters of mercury. The injection was done as soon as the specimen had returned to room temperature. All injections were done through the descending thoracic aorta and any leaks which had not been previously cared for were immediately stopped by applying a pledget of cotton moistened with a few drops of acetic acid. Following the injection the specimen was placed in a large jar of 5 per cent acetic acid and 10 per cent formalin, the abdomen

¹Nooprene.

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being opened to admit the fixing fluid. After 12 to 24 hours in this medium the specimen was removed and the ureteral blood supply was dissected out with the aid of a magnifying loupe. The ureteral vessels in the fetus are extremely small and delicate but their consistency after injection allowed for a satisfactory dissection. Though no attempt was made to corrode these specimens two block dissections of the abdomen and pelvis were cleared in wintergreen oil to afford a closer study of these fine vessels.

A total of 16 ureters were studied in 8 specimens but due to a seemingly incomplete injection of one only the results as found in 7 (see Table I) Before presenting the detailed findings in 2 of these specimens a general description of the blood supply to the ureter as found during this study will be given.

The ureter receives its chief blood supply from what may be called long arteries which arise either from one or more of the following major vessels: the lower end of the abdominal aorta, just before its bifurcation; the common iliac artery or the hypogastric artery. Where the origin is from the common iliac or hypogastric the ureteral arteries invariably arise from the medial side of these vessels and cross the artery of origin laterally to reach the medial side of the ureter where it divides into a T with an ascending and a descending branch which may course for practically the whole length of the ureter. These longitudinal branches are of the same caliber as the ureteral artery and are found in the loose adipose areolar tissue capsule of the ureter. These ascending and descending primary branches anastomose with similar branches above from the renal, spermatic or ovarian arteries and below with similar branches from the uterine and vaginal arteries. In addition to branches on the inferior and occasionally the superior iliac and middle hemorrhoidal arteries. In several instances the branches from the superior spermatic (ovarian) uterine, vaginal, and the inferior vesical arteries may be considered as arteries which mainly supply that part of the ureter in their immediate vicinity. In several cases the main blood supply to the ureter was found to be multiple.

As first noted by Fitel the arteries to the upper portion of the ureter (renal, aorta, common iliac, and hypogastric) reach the ureter on its medial side while those supplying the terminal portion (uterine vaginal and vesical branches) reach the ureter on the lateral side. The long ureteral arteries in turn give off many small branches which ramify around and over the ureter anastomosing with each other on all sides above and below from the renal pelvis to the bladder. These secondary branches in turn give off many minute branches which pierce the muscular coat of the ureter. Details of the anastomoses of these terminal branches were not determined but it is evident as Sampson (44) has reported, that anastomoses of this third set of arteries are not as abundant as in the other two sets. Serial sections of ureters obtained from two adults at postmortem examination during this study revealed a rich blood supply of the muscularis and mucosa but no definite anastomosis of these vessels could be determined. Frommolt (15) however claims that these fine branches anastomose with each other in the muscular coat of the ureter. In contrast to the longitudinal branches the secondary branches of the ureteral arteries are quite closely adherent to the muscular coat, and these are not likely to be injured except by direct trauma whereas the primary long ureteral branches may be readily damaged in either dissection of the ureter from the parametrium or during pelvic lymphadenectomy.

It has been demonstrated in dogs (29, 44) and in man, (15, 20, 56) that the ureter may be isolated or stripped for relatively great distances without subsequent necrosis. The safety factor lies in the multiple blood supply to the ureter and the rich anastomoses of the primary and secondary branches of the ureter not only locally but from the kidney pelvis to the bladder. Sampson (44) demonstrated this by studying the efficiency of the ureteral blood supply by injecting a mass through various ureteral arteries. Therefore, if one ureteral artery is destroyed it may be possible for other branches to take over the blood supply. That this is true is not disputed, for in hundreds of Wertheim operations where the ureter has been described as running through the pelvis

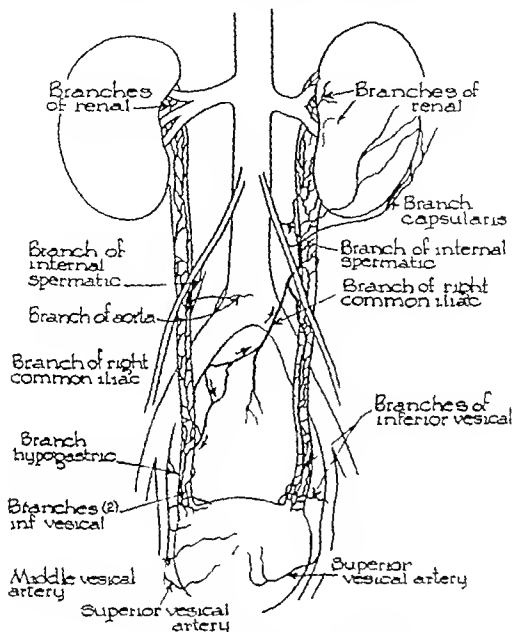


Fig. 1 Arterial blood supply of ureters of the male

like a telephone wire following its free dissection relatively few fistulas have developed. However there must be cases of failure of this remarkable collateral circulation due to excessive robbing of blood supply coupled with vasospasm or disturbance by exudates, hematomas, trauma, and other pathological conditions of the secondary vessels of the ureter. There must be cases also in which the finer secondary branches which firmly cling to the ureter are directly traumatized in a limited region; thus may not be evident at the time of operation. Another factor is that carcinoma of the cervix occurs in the later decades of life when the smaller arteries and arterioles may

have become less efficient as a result of changes associated with age.

It is obvious that to guard against necrosis of the ureter it is imperative to minimize damage to the ureteral blood supply during isolation of the ureters in the Wertheim operation. It is not advisable to ligate the internal iliac artery routinely as this may readily predispose to a further cutting down of the blood supply to the pelvic ureter. The branches of the uterine and vaginal arteries must of necessity be destroyed during the operation and the vesical branches are often inadvertently injured because of their positions. The burden may therefore rest with the main ureteral

ine arteries. These longitudinal branches are loosely connected to the ureter and are contained within an adipose fibrous sheet. Secondary branches given off from these primary arteries arborize over the ureter for its entire length and anastomose freely with each other above and below and form a compact perireteral anastomosis from the renal pelvis to the bladder. A third set of arteries is given off from those vessels around the ureter and these in turn pierce the muscularis of the ureter to supply the wall.

6 Prophylaxis is the best treatment for this complication. In addition to a proficient knowledge of the normal and abnormal anatomy of the ureter one must meticulously and gently dissect the ureter from its bed using every caution not only to preserve the perireteral arterial plexus but also carefully to dissect out and preserve the blood vessels to the ureter. These latter vessels are also to be avoided during pelvic lymphadenectomy. The avoidance of other contributing factors such as mass ligation, use of drains too close to the ureter etc. are discussed. A survey of the suggestion of hypogastric block or resection to increase the blood supply to the ureter as an additional prophylactic aid.

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HYPERTROPHIC PYLORIC STENOSIS

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PYLORIC stenosis is the most common condition requiring surgical treatment in the first few months of life (12). The diagnosis is being made more and more frequently. Ladd (12) states that the operative attack on pyloric stenosis marks one of the greatest advances in abdominal surgery in the last 20 years.

Two hundred and forty-eight cases of pyloric stenosis have been admitted to Milwaukee Children's Hospital between June 1924 and May 1947. The Fredet Rammstedt pyloromyotomy was done on 232 of these and 15 were not operated upon. Sixteen deaths have occurred in this series, 9 of which were postoperative deaths. The 7 other cases were treated medically.

There has been no death during the past 10 years, during which time diagnoses were made and operations performed in 172 infants. We believe that we can point out several reasons responsible for this drop in mortality rate.

INCIDENCE

The majority of cases of pyloric stenosis occur in males. Our series show a preponderance of 65 males to 1 female, or 86 per cent in males. Ladd reported 85 per cent. Fredeen 78 per cent.

Our records show that 1 in 213 children admitted to Milwaukee Children's Hospital had pyloric stenosis. Cranmer estimates that 1 in 400 male infants is affected. Wallgren reviewed the records of all children born in Göteborg, Sweden from 1934 to 1940 and found that among 25,642 children born 102, or 0.4 per cent, developed pyloric stenosis. This is 1 in 250 births. On studying further he found the incidence to be 1 in 770 girls born and 1 in 154 boys born. These figures would not necessarily be significant for this country since it is well known that the disease is common in some races that it is rare in others

and that we represent a mixture of all the races.

Wallgren called attention to Eckstein's report that he observed only 2 children with pyloric stenosis among 50,000 patients treated in the out patient department for children's diseases at Ankara, Turkey, and that the parents of these children were foreign born, also, that a pediatrically trained medical missionary found only one case during many years in the Belgian Congo and that this patient was of French parentage.

There were no negroes in our series. Fredeen reports 1 negro female in 32 cases at the University of Kansas. Romano reports 30 per cent in negroes from the Charity Hospital in New Orleans.

It has frequently been reported that the majority of cases are found in the first born of a family. Our figures bear this out. First born constituted 43 per cent of our cases, second born 21 per cent, third born 16 per cent, and fourth born 5 per cent. One case was the 12th child in the family. None of the first 11 children had been affected.

About half of our cases were breast fed and the other half were artificially fed. We can find no justification of some claims that pyloric stenosis occurs most often in artificially fed babies.

Seventy per cent of the patients in this series were between the ages of 3 and 6 weeks. The youngest was 10 days old and the oldest was 7 months. MacHaffie of Canada reports an infant that was operated on 34 hours after birth. Reports have been numerous of pyloric stenosis in adults (2, 11). The majority of these are diagnosed either in the specimen removed during a subtotal gastric resection for suspected carcinoma, or at the autopsy table.

Our series contained 9 instances in which more than one member of the family was affected with pyloric stenosis. In one family there were 3 cases, 2 boys and a girl. In

From the Surgical Service of the Milwaukee Children's Hospital.

At times it is very difficult or impossible to feel

Ladd Ware and Pickett felt the tumor in over 98 per cent of cases. Brown of Nebraska felt the tumor in 44 per cent of cases. Our records show that a tumor was felt in 63 per cent of cases. However, several individuals with considerable experience were able to feel about 90 per cent in the cases with which they were associated.

DIAGNOSIS

Projectile vomiting is usually the first symptom to call the examiner's attention to this condition. It should stimulate him to inquire into the bowel habits and weight gain of the patient and to seek the peristaltic waves and palpate the pyloric tumor. Occasionally the mother will volunteer the information that she has seen 'knots going across the stomach' but usually the examiner must stimulate the production of the peristaltic waves himself. This is easily done by placing the undressed patient between the examiner and a window or light and giving the patient some water to drink. The peristaltic waves begin in the left upper quadrant and progress diagonally down and across the abdomen above the umbilicus. Usually two waves the size of a half golf ball are evident with a depression between them. The waves cast a shadow into the depression as they move across the abdomen from left to right.

Peristaltic waves are seen in other conditions, such as pylorospasm and therefore are not diagnostic without other accompanying symptoms. Peristaltic waves running from right to left are indicative of large bowel pathology and may be confused with the gastric peristaltic waves which are found in pyloric stenosis.

A palpable pyloric tumor is pathognomonic of pyloric stenosis and is therefore the most important finding for establishing the diagnosis. Occasionally the tumor is easily felt, but usually considerable dexterity and experience are required to palpate even a markedly enlarged pylorus since the majority of patients are hypertonic and crying when first seen in the examining room. Our records show very plainly that the highest percentage of

tumors are felt by those who have the greatest experience and those who make their examination under the proper conditions. The tumor is most easily felt in the manner described by Seeger.

The operator is seated at the right of the examining table and the right hand is used to palpate the abdomen while the left hand is placed beneath the patient to give counter pressure from below. Usually the olive shaped tumor is felt near the midline in the right upper quadrant just beneath the edge of the rectus muscle. It is quite mobile and can sometimes be rolled against the prominent spine. Often its position can be determined by watching the point where the peristaltic waves end.

A palpable tumor is positive evidence of pyloric stenosis. Failure to palpate a tumor is not conclusive proof to the contrary. (10)

During the past few years we have become more and more aware that roentgenologic examination is one of the most important procedures available in the diagnosis of pyloric stenosis. We agree that if pyloric tumors were 100 per cent palpable there would be little value in subjecting the patient to this procedure but in our series the tumor was palpable in only 63 per cent of cases. Series reported in the literature record the tumor as being variously palpable from 24 per cent (17) to 98 per cent (13).

In reviewing the records of 187 cases of pylorospasm seen at Milwaukee Children's Hospital between 1914 and 1947 6 cases were found in which examiners reported feeling the pyloric tumor. In all of these, subsequent roentgenologic examination was done and reported negative for pyloric stenosis. In spite of the negative x ray report, 1 patient was operated upon and a normal pylorus was found at operation.

In 3 other cases examiners reported feeling the pyloric tumor, but no x ray examinations were made before operation. In all of these a normal pylorus was found during operation. One of the 3 later died of septicemia. It is evident, then that our only pathognomonic finding is not 100 per cent reliable.

When properly performed roentgen examination is almost 100 per cent reliable. The

pyloric tumor containing barium casts a typical shadow of the stenosed pyloric canal which is funnel shaped at its entrance and long and narrow through its lumen. This has been described by Heske as a prepyloric narrowing and the string sign. Delayed opening time and gastric retention of barium are helpful in making the diagnosis but the 'prepyloric narrowing' and the string sign give an exact picture of the stenosed pyloric canal which is not simulated by any other condition.

Many authorities object to the use of roentgen examination because of the possibility of aspiration of barium or because of the difficulties that the barium might cause at operation. These same authorities recommend that full formula feedings be maintained during the preoperative period regardless of the vomiting.

We do not believe that the danger of aspiration of barium is any greater than the danger of aspirating vomitus from the periodic full formula feedings recommended during the preoperative period.

In all of our cases the stomach is lavaged after the roentgen procedure and before operation and there has been no difficulty from any residual barium in the stomach.

The x ray procedure is carried out in the following manner:

The patient is given no food for 6 hours to insure that the stomach is empty; then the patient is given 2 ounces of formula barium mixture and the patient is observed under the fluoroscope. Roentgenograms are taken at 5 minutes and 30 minutes in positions determined by fluoroscopy to show the best view of the pyloric canal. This is invariably a right oblique position. If the canal is well visualized in the 30 minute film no more films are taken; otherwise subsequent 1 and 2 hour films are taken until a good view of the canal is obtained.

TREATMENT

The evolution in the surgical treatment of pyloric stenosis is very interesting and its beginning dates back to 1892 when Cordus of Hamburg, Germany, performed the first surgical procedure—a jejunostomy with an unsuccessful outcome (8).

Four methods of surgical treatment have been in use (1). The first and most unsuccessful was the Loreta division of the pylorus in which an incision was made into the anterior wall of the stomach and graduated sounds were passed into the stomach and through the pylorus stretching its lumen. Usually the pyloric mass broke rather than stretched, and the patient died of peritonitis.

The second operation was a simple pyloroplasty advocated by Dent in 1902. A longitudinal incision was made through the tumor extending from the stomach to the duodenum, cutting through all layers including the mucosa. This longitudinal incision was then transformed into a transverse incision by bringing the ends together with sutures in the manner of the Heineke-Mikulicz operation. The mortality rate, however, was too high. Surgeons began doing gastroenterostomy with which many were familiar. Even so the mortality rate was very high.

In 1906 Nicoll began doing a partial pyloroplasty in which only the muscle and not the mucosa was incised. He made a V shaped incision through the tumor at right angles to the long axis and by converting it into a Y increased the diameter of the lumen. This was the first of the submucous pyloroplasty operations.

In 1908 Fredet made a longitudinal incision through the muscle layer not opening the mucosa, and converted it into a transverse incision in order to increase the lumen diameter by bringing the two ends together with sutures.

In 1911 Rammstedt was performing the Fredet submucous pyloroplasty and found that he could not get the ends together because his sutures tore out of the edematous hyperplastic tumor, so he sutured the omentum over the incision and closed the abdomen. The patient got along very well. In 1912 during another operation he incised the pyloric muscle and left the defect uncovered in the manner in which the operation is performed today. The patient made an uneventful recovery. This procedure is essentially the same operation that is universally carried out today and is known as the Fredet Rammstedt pyloromyotomy.

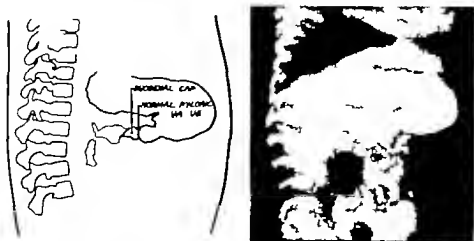


Fig 1 a, left, Diagram of normal pylorus. b Roentgenogram of normal pylorus.



Fig 2 a, left, Diagram of case of hypertrophic pyloric stenosis. b Roentgenogram of same case showing hypertrophic pyloric stenosis.

PREOPERATIVE TREATMENT

Probably the greatest aid in the reduction of operative mortality rated during the past 10 years has been early diagnosis and adequate preoperative care.

Pyloric stenosis is no longer considered an emergency. Operation is frequently postponed 24 to 48 hours in a particularly dehydrated individual while fluids are given to hydrate the patient and to re-establish electrolyte balance. Usually 60 to 100 cubic centimeters of Ringer's solution is given subcutaneously every 6 to 8 hours depending upon the degree of dehydration which is present and upon the size of the patient.

Some writers have used parenteral amino acids preoperatively in particularly malnourished and dehydrated patients either intravenously or subcutaneously and have reported gratifying results. A few years ago the proper

diagnosis occasionally was not made until the patient was marasmic. These patients were given preoperative transfusions together with parenteral fluids. During the past few years it has been routine at Milwaukee Children's Hospital to give the patient a transfusion before leaving the operating room, 10 cubic centimeters per pound body weight of whole blood being given by the multiple syringe method. This transfusion corrects the depleted serum protein and brings the lowered red blood cell count and hemoglobin values up to a satisfactory level, giving the patient an added boost to carry him through the immediate postoperative period until he can care for his own nutritional requirements. We believe that this procedure has been very instrumental in lessening postoperative complications and at the same time in making for an easier convalescence.



Fig. 3. a, left, Diagram of another case of hypertrophic pyloric stenosis. b Roentgenogram of same case.

OPERATION

It is almost universally agreed that the Fredet Rammstedt pyloromyotomy is the operation of choice in the surgical treatment of pyloric stenosis. This operation was used in all of the cases which were surgically treated in this series.

The correct type of abdominal incision to use is still a matter of discussion. Three types of incision were most generally used in this series. Many of the earlier surgeons made no record of the type of incision used so no accurate account can be given. The earliest incision to be used was the right rectus incision which remained popular until Robertson described the gridiron incision in 1940. For about 3 years after that various adaptations of the gridiron incision were used. The most popular of these was Meredith's adaptation in which a regular right rectus incision was used but in which the posterior rectus sheath and peritoneum was opened transversely. In 1943 the majority of surgeons reverted back to the right rectus incision but made it high just beneath the rib margin in order to utilize the liver as a stop-plug to block the intestines from extruding through the wound. After closure of the wound the right lower margin of the liver slides back into place behind the incision and prevents the intra-abdominal pressure from being exerted directly against the incision. This type of incision is most popular today and it has been found that in no case has wound dehiscence or incisional hernias resulted.

The pyloric tumor is usually quite mobile and is easily brought into the abdominal opening. A longitudinal incision is made through the serosa and slightly into the hypertrophied muscle at the superior border which is usually the most avascular area while the assistant holds the duodenum and stomach rotating the pyloric tumor downward to present the superior avascular area. No attempt is made to cut entirely through the muscle, but only through the serosal layer from the stomach to the duodenum separating only the most superficial muscle fibers. The closed points of a small artery forceps are inserted into the incision and spread breaking through the muscle fibers which make up the tumor. This is carefully carried out until the underlying mucosa is freed of the surrounding fibers and bulges through the incision. At the stomach end of the tumor the muscle fibers gradually blend into those of the stomach but at the duodenal end the muscle fibers end bluntly extending into the duodenal lumen in the manner of the cervix into the vagina. It is here that great care must be exercised in separating the muscle fibers, since the closely investing mucosa of the duodenum is easily torn in the process, and if this accident is not detected the resultant leaking will cause peritonitis.

When the incision is made in the avascular area, very little bleeding results. The small amount of oozing can be controlled with warm moist packs. Large bleeders are difficult to ligate in the edematous tumor and occasionally a stitch tie is required. In some of the

earliest operations, omentum was sutured over the defect in the pylorus, but this is seldom done anymore.

After the pylorus is returned to the abdomen the wall is closed in layers.

The anesthetic of choice in this series has been open drop ether. Procaine infiltration anesthesia was formerly used but has been almost entirely abandoned during the past few years.

POSTOPERATIVE TREATMENT

Considerable controversy exists concerning the proper postoperative treatment of pyloric stenosis. Some authorities advocate immediate full formula feedings while others give nothing by mouth during the first 24 hours after operation.

Faber and Davis of Stanford gave 10 infants a teaspoonful of barium sulfate suspended in 1 ounce of water from 1 to 5 hours after the standard Fredet Rammstedt pyloromyotomy. Periodic examinations with fluoroscopy and x rays were made to determine the rate and extent of emptying of the stomach immediately following operation. They found that in the average case the evacuation of the barium from the stomach did not begin for over 8 hours and that evacuation was not complete for 24 hours. Basing their argument on these findings they do not believe that early and frequent administration of food and water during the immediate 24 hour postoperative period is desirable.

Our routine postoperative feeding schedule has been a compromise between these two extremes.

The patient is given $\frac{1}{2}$ dram of water 1 hour after operation and the water is increased by $\frac{1}{2}$ dram every 2 hours. Two hours after operation the patient is given $\frac{1}{2}$ dram of formula and this is given every 2 hours with an increase of $\frac{1}{2}$ dram for each feeding until the patient has received eight feedings of water and eight feedings of formula. The patient is not awakened during the night for feedings. On the second day $\frac{1}{2}$ ounce of formula is given every hour and the water is discontinued. On the third day 1 ounce of formula is given every 2 hours. On the fourth day 2 ounces of formula are given every 2 hours. On the fifth

day the normal feeding schedule is resumed.

If the patient persists in vomiting the feedings are reverted back to the last change.

In our series 23 per cent had a slight amount of postoperative vomiting not requiring a decrease in formula feedings, 5 per cent required changes in formula feedings and in 3 cases reoperation was necessary.

It was seldom necessary to give parenteral fluids after operation because of severe vomiting.

The skin sutures were usually removed on the seventh or eighth day and the patient was discharged on the ninth or tenth day.

TABLE I — COMPLICATIONS

	0 to 24 1 to 24	25 to 48 1 to 48	49 to 72 1 to 72	73 to 96 1 to 96	97 to 120 1 to 120	121 to 144 1 to 144	Total %
Accidental duodenal perforation			3	5	7	3	9
Wound infections	4						5
Dehiscence of wound after infection							6
Bronchopneumonia		3					4
Otitis media	3						5
Recurrentes			1				3
Hernia of wound							8
Hemorrhage							4

*One died

†Three died

Accidental perforation of the mucosa. The most frequent complication in our series, and the one most commonly warned against in the literature is accidental perforation of the duodenal mucosa. This complication occurred 21 times in our series of cases. Ladd (12) reported 23 perforations in his series of 1000 cases.

It should be routine for every operator to test for possible perforation by squeezing the stomach and duodenum together and watching for the escape of gas bubbles.

Wound infection. Wound infection was the second most common complication occurring in 12 cases. Four of these resulted in dehiscence of the incision and 1 of the 4 died of a resulting peritonitis.

Upper respiratory infection. was a complication in 12 cases. Half of these patients developed otitis media and the remaining suffered with nasopharyngitis.

TABLE II—OPERATIVE MORTALITY—232 PATIENTS OPERATED UPON WITH 9 DEATHS—3.8 PER CENT MORTALITY

935—Peritonitis (recurrence reoperated upon) (autopsy)
93—Peritonitis (recurrence reoperated upon) (autopsy)
93—Bronchopneumonia (autopsy)
929—Inanition—dehydration (autopsy)
938—Bronchopneumonia (autopsy)
928—Bronchopneumonia (autopsy)
937—Peritonitis (sound dehiscence) (autopsy)
920—Peritonitis (autopsy)
935—Bronchopneumonia (no autopsy)

TABLE III—MEDICALLY TREATED MORTALITY—15 PATIENTS TREATED MEDICALLY WITH 7 DEATHS—46.6 PER CENT MORTALITY

937—Pyloric obstruction—inanition
934—Pyloric obstruction—inanition
931—Pyloric obstruction—bronchopneumonia
929—Pyloric obstruction—malnutrition
927—Pyloric obstruction—bronchopneumonia
937—Pyloric obstruction—bronchopneumonia
926—Pyloric obstruction—malnutrition
(All are proved by autopsy)

Bronchopneumonia Bronchopneumonia was a complication in 7 cases. Four of these in infants died.

Postoperative vomiting Severe vomiting continued postoperatively in 12 cases and had to be treated with atropine. In 3 of these a diagnosis of recurrence was made and the infants were operated upon a second time to separate the muscle fibers which had been incompletely separated during the first operation. Two of the 3 died of peritonitis. The duodenum was accidentally perforated in the remaining case during the second operation but the accident was noted and the defect was closed with a mattress suture.

Recurrences There were 5 cases of recurrence in our series. Three of these received both their first and second operation here. The 2 remaining were operated upon elsewhere the first time and came to Milwaukee Children's Hospital for their second operation. It is possible that some of our patients were reoperated upon elsewhere because of recurrences but no such case has been brought to our attention.

Diarrhea Severe diarrhea complicated 4 cases resulting in prolonged hospital stay but not ending in any fatalities.

Hernia Postoperative abdominal hernias occurred in 2 cases. In both instances low right rectus incisions had been used.

Hemorrhage There was 1 case of intra-abdominal bleeding in which hemoglobin dropped to 3.5 grams. Transfusions were given and the bleeding stopped spontaneously. The remaining convalescence was uneventful.

MORTALITY—TABLES II AND III

Of the 247 patients treated for pyloric stenosis at Milwaukee Children's Hospital 16 died making a mortality rate of 6.4 per cent.

Two hundred and thirty two were treated surgically with 9 deaths giving an operative mortality rate of 3.8 per cent.

Of the 15 remaining patients treated medically 7 died with a mortality rate of 46.6 per cent.

There has been no death during the past 10 years and 172 patients have been operated on consecutively without a fatality.

This compares favorably with large series reported in the literature.

Ladd (13) reporting 1000 cases had an overall operative mortality rate of 4 per cent and had operated upon 225 consecutive patients without a death.

SUMMARY

1 The hospital records of 248 cases of pyloric stenosis were reviewed.

2 There were 9 instances in which more than one member of a family was affected and 7 instances in which one of a set of twins had the disease.

3 Biopsies of the pyloric tumor taken in 72 cases during operation and microscopic study revealed that the longitudinal as well as the circular smooth muscle fibers were involved.

4 Peristaltic waves were visible in 83 per cent of cases and tumors were palpable in 63 per cent of cases.

5 Roentgenologic examination too little used is a valuable diagnostic procedure since physical examination is not 100 per cent reliable.

6 Early diagnosis and adequate preoperative care are responsible for the reduction in mortality rate.

7 Routine blood transfusions at the time of operation make for a smoother convalescence and a reduction in postoperative complications.

8 There has been no death during the past 10 years and 172 consecutive patients have been operated on without a fatality

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INFRARED PHOTOGRAPHIC STUDY OF THE SUPERFICIAL VEINS OF THE THORAX IN RELATION TO BREAST TUMORS

A Preliminary Report

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NORMAL patterns of the superficial veins in the living human body have been photographed by infrared photography and are recorded in the medical literature. In previous publications it has been shown also that infrared photography is of value in recording the changes in the superficial venous pattern caused by any condition which affects the circulation.

PURPOSE

This study is based on a survey of 100 cases of breast complaints entering the dispensary of the Marquette University School of Medicine from the Cancer Detection Center of the Medical Society of Milwaukee County. The object was to ascertain (1) whether a tumor within the breast would alter or disturb the pattern of the superficial veins of the thorax, (2) whether the infrared photograph might serve as an aid in determining whether the tumor was malignant or benign and (3) whether the infrared photographic method might be of any practical assistance in the diagnosis of cancer of the breast.

In approaching the problem it might be well to offer first of all some clue as to the nature of the types of venous patterns found in the normal human chest. For purposes of simplicity these venous patterns are referred to as infrared phlebograms and are classified into two types: longitudinal (Figs. 1 and 3) and transverse (Figs. 2 and 4). The *longitudinal* type radiates in a fan like pattern downward and laterally into the breasts from the point where the anterior jugular vein connects with the arch of the jugular vein (Fig. 1 A). This

pattern seems to be associated with the pendulous type of breast. The *transverse* type pattern radiates laterally in both directions from the pectoral venous plexus (Fig. 2 B) toward the axillary and costoxillary regions. The transverse type pattern is usually found in the normal youthful type of breast.

MATERIALS AND METHODS

Photographic materials, methods, and various applications of infrared photography have been discussed in previous publications. Any camera may be used. The image is focused with a Wratten No. 25 filter over the lens; this filter is then replaced with a Wratten No. 87 filter and the diaphragm is closed to the f 32 stop. The photograph is made on Eastman infrared sensitive film or plates. The back of the camera is tilted slightly upward to bring the plane of the film parallel with the plane formed by the protruding breasts. This is particularly necessary if the breasts are large.

The most convenient and efficient source of illumination for use with infrared sensitive emulsions is the incandescent tungsten filament lamp. In Figures 1 to 16 the patient is illuminated from each side by a vertical bank of five 100 watt lamps directed toward the chest and two 500 watt lamps directed toward the chest at an angle of about 45 degrees, 36 inches away from the patient. It is important to strive for flat illumination for very slight differences of light intensity are recorded with extreme contrast on the infrared sensitive emulsion. Movement is controlled by asking the patient to hold her breath. The exposure time is $\frac{1}{6}$ second. Infrared sensitive emulsions are loaded and processed in total darkness.

From the Department of Anatomy Marquette University School of Medicine.

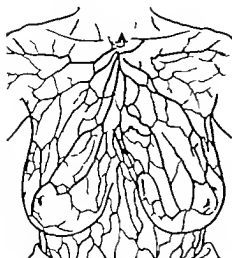


Fig. 1

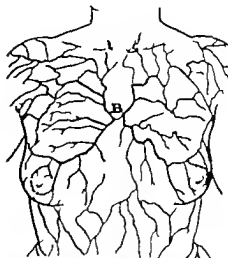


Fig. 2

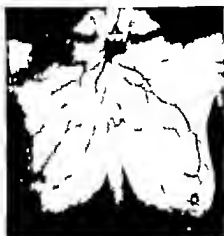


Fig. 3



Fig. 4

CASE REPORTS

Mrs. B. 40 years of age, weight 125 pounds, with one child 13 years old, entered clinic with no complaint but for checkup only. Infrared phlebogram revealed a symmetrical pattern of equal photographic density of the superficial veins in both mammary glands and pectoral regions, transverse type (Fig. 5).

Mrs. D. 35 years of age, weight 131 pounds, no children, had fibrocystic disease of both breasts. Infrared phlebogram revealed an undisturbed symmetrical pattern of the superficial veins in both mammary glands and pectoral regions. The veins just above the areola in each breast border on varicose, longitudinal type (Fig. 6).

Mrs. O. D. 37 years of age, weight 115 pounds, 2 children, had a tumor in right breast. Infrared phlebogram demonstrated an undisturbed symmetrical pattern of equal photographic density of the superficial veins in both mammary glands and pectoral regions. The pattern is revealed with unusual clarity, longitudinal type (Fig. 7). Pathologic examination revealed fibrocystic disease of the breast.

Mrs. J. 53 years of age, weight 138 pounds, 2 children, had a lump in the left breast. Infrared

phlebogram shows the superficial veins in the left mammary gland to be quite conspicuous, while those in the right breast are only faintly visible. There is also some engorgement of the veins which extend transversely across the left breast just above the nipple, longitudinal type (Fig. 8). Pathologic examination revealed adenocarcinoma, scirrhous type, grade III, with involvement of axillary nodes.

Mrs. B. 29 years of age, weight 168 pounds, 5 children, had a lump in right breast. Infrared phlebogram showed the superficial veins in both mammary glands and pectoral regions to be undisturbed, asymmetrical in pattern and of equal density, longitudinal type (Fig. 9). Pathologic examination revealed adenofibrosis of the breast with a solitary cyst.

Mrs. R. 50 years of age, weight 206 pounds, 3 children, had a painful lump in the left breast. Infrared phlebogram showed the venous pattern in the left mammary gland to be irregular in pattern and density, with engorgement of a vein in the pectoral plexus. A retracted area was present in the left breast just lateral to the nipple; this breast was distorted in shape. Slight changes in the shape of the



Fig. 5



Fig. 6



Fig. 7



Fig. 8

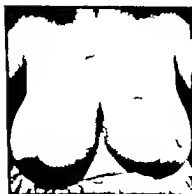


Fig. 9



Fig. 10



Fig. 11

breast are difficult to see upon visual inspection; the photograph, however, brings both breasts within the focus of the eyes, thus revealing these slight distortions quite clearly. The regularity of the venous pattern and density in the right breast contrasts greatly with those in the left (Fig. 11). Pathologic examination revealed scirrhous carcinoma with metastasis to lymph nodes—longitudinal type.

Mrs. C., 35 years of age, weight 126 pounds, 1 child, had a lump in the left breast. Infrared plethogram showed the superficial veins in both mammary glands and pectoral regions to be undisturbed and of equal distribution and density (Fig. 11). Pathologic examination revealed fibrocystic changes within a previous adenoma, with no evidence of malignancy. Transverse type.



Fig. 12



Fig. 13



Fig. 14



Fig. 15a.



Fig. 15b



Fig. 16a.



Fig. 16b.

Mrs H R. 55 years of age weight 151 pounds 10 children had an advanced carcinoma of the right mammary gland (Fig. 2)

Mrs K. 41 years of age weight 143 pounds 1 child had a painful lump in the left breast. Infrared phlebogram showed the superficial veins in the left breast more conspicuously than those in the right (Fig. 13). They are indefinite in outline and are somewhat enlarged. Note the wrinkle at the arrow. U lateral wrinkling just below the nipple has been observed in the photographs in a number of cases which proved to be malignant. It is probably caused by a lesion in the breast which produces a beginning retraction of the nipple. This slight wrinkling can be overlooked easily at visual inspection but is revealed very clearly in the photograph. Pathologic examination revealed a medullary carcinoma located deep in the left breast with some metastatic nodules present within the breast tissue.

Mrs B. 49 years of age weight 120 pounds no children, noticed a lump in the right breast a year ago which has increased in size. Infrared phlebogram shows the right breast to be distorted. There is a lump in the upper lateral quadrant and areas of unequal density below and above the nipple (Fig. 14). Note the three shallow wrinkles below the right nipple indicating greater retraction of the nipple than that seen in Figure 13. Pathologic examination revealed a scirrhous carcinoma with regional lymph gland metastasis.

Mrs V B. 35 years of age weight 116 pounds no children was operated upon 6 years previously for cyst in the right mammary gland posteriorly. A lump recurred slightly anterior to the old scar. There is drainage through the nipple with constant pain. Infrared phlebogram anterior view (Fig. 15a) shows that the superficial veins in the right mammary gland are more conspicuous than those in the left. The outline of a lump can be seen in the axillary region on the right side. In the lateral view (Fig. 15b) the patient's arm is raised over her head thus flattening the surface in the axillary region. Note the area of increased density indicated by the arrow just anterior to the scar of the previous operation. This area of density in the infrared photograph could not be seen upon inspection. There is a confluence of the veins toward this dark area. Pathologic examination revealed an adenocarcinoma, grade III without demonstrable axillary involvement.

This patient, a woman 63 years of age weight 51 pounds, with 1 child had a tumor mass with super-

ficial lesion in right mammary gland. Medullary type of carcinoma (Figs. 16a and 16b)

CONCLUSIONS

Of the 100 cases of breast complaints studied 65 were tumors. Following the study of about 75 cases of breast tumors, certain standards in the interpretation of the infrared phlebogram were established. In at least 6 patients brought in subsequently the phlebogram did not agree with the clinical diagnosis. In all of these cases, however the pathologic diagnosis confirmed the findings in the infrared phlebogram.

As a result of this limited study by infrared phlebogram the tentative conclusions are made

1 In some breast tumors the appearance and pattern of the superficial veins of the thorax are altered

2 The infrared photograph reveals information difficult to obtain upon unaided visual inspection and in some cases impossible to obtain in any way other than by an infrared phlebogram

3 Further study of many more benign and malignant tumors might indicate that the infrared phlebogram may serve as an additional adjunct in the detection and classification of tumors of the breast.

Realizing that the evaluation of the infrared phlebogram in the study of breast tumors can be established only by its general use, this laboratory is prepared to co-operate with others in the use of this simple procedure

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REPAIR IN THE NORMAL AND HYPERACID STOMACH

An Experimental Study

PHILIP B PRICE, M.D., F.A.C.S Salt Lake City Utah

A RECENT experimental study of gastric digestion of living autogenous tissue provided unusual opportunities to observe the process of repair of wounds and incisions in the normal and hyperacid canine stomach. Those observations led to the present investigation.

A large number of healthy dogs were used. Discs of mucosa were excised from the gastric wall and incisions and anastomoses of various sorts were made. The animals were sacrificed at selected intervals to note the progress of repair.

About half of the animals received daily intramuscular injections of histamine in beeswax beginning 24 hours after operation. The fasting gastric contents of this group of dogs averaged 91 units of free acid and 124 units of total acid. The other group which received no histamine had on the average 22 units of free acid and 61 units of total acid.

No 60 cotton thread was used for the most part as suture material. Both cotton and fine catgut were tried in mucosa to-mucosa suturing.

REPAIR OF WOUNDS IN THE NORMAL STOMACH

In the postoperative stomach of an other wise normal dog repair proceeds in a characteristic manner. Figure 1 illustrates schematically the healing process after a disc of mucosa and submucosa has been excised. First there is proliferation of fibroblasts and granulation tissue in the base of the defect (Fig. 1B) and turning down of the mucosal margins. This latter effect is probably due to digestion of underlying supportive submucosa. In a later stage of repair the base is heaped up with granulation tissue which may be covered with

a thin slough of necrotic material. The wound is now smaller thanks to fibrous and muscular contraction and the extreme laxity of the submucosa (Fig. 1C). From the under margins of the crests of mucosa new epithelium extends in sheets across the defect. At length the crests of mucosa meet like the heads of two rams (Fig. 1D) and the base becomes completely epithelialized. When that has occurred digestion of tissue by gastric juice ceases and signs of inflammation subside.

Figure 2 is a photomicrograph of the margin of a healing wound after 4 days. The rounded crest of mucosa appears on the far left. There is a beginning of gland formation as well as active proliferation of epithelium which extends over the granulation tissue in the base of the wound. The muscularis mucosae is not seen in this view as it lags behind the advancing ram's head of mucosa.

If the original wound is large so that final healing is long delayed the advancing margin of mucous membrane may be edematous (Fig. 3). In this edematous stroma one may see newly formed capillaries and lymph channels.

Figure 4 shows an originally large wound now almost completely healed. Beneath the mucosal union the muscularis mucosae layers approach each other. Healing at length will be so perfect that it is hard to find the scar.

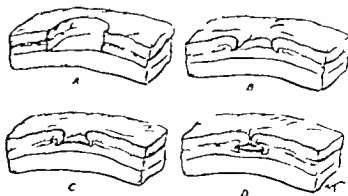


Fig. 1. Diagrammatic representation of stages in the repair of a wound in the mucosa of a normal stomach.

From the Department of Surgery, University of Utah School of Medicine, Salt Lake City, Utah.

Presented in the Forum on Fundamental Surgical Problems before the Clinical Congress of the American College of Surgeons, Cleveland, Ohio, December 16-20, 1916.



Fig. 1



Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7



Fig. 8

Fig. 1. The healing edge of an artificial mucosal defect, after 4 days, normal acidity.

Fig. 3. The healing edge of a very large mucosal defect, after 7 days, normal acidity.

Fig. 4. A large mucosal defect, virtually healed after 37 days, normal acidity. The remains of a cotton suture are seen in the center of the field.

Fig. 5. The edge of an artificial mucosal defect, after 3 days of hyperacidity.

Fig. 6. The edge of a mucosal wound, after 3 days of hyperacidity. The upper left-hand portion of the field is filled with cellular and necrotic debris being discharged into the lumen of the stomach.

Fig. 7. The edge of an acute spontaneous duodenal ulcer after 3 days of histamine injections.

Fig. 8. The edge of a gastric mucosal defect after 9 days of hyperacidity.

even on microscopic section. That is the normal process of healing.

REPAIR OF WOUNDS IN THE HYPERACID STOMACH

A very different picture is presented, however, when the gastric acidity is increased by

daily intramuscular injection of histamine in beeswax. There is no evidence of epithelial proliferation on the third day (Fig. 5); instead, there are obvious erosion and disintegration of both margin and base of the wound.

One day later there is an effort at proliferation deep in the projecting sulcus of the ram-



Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7



Fig. 8



Fig. 9

Fig. 3 Cross section of the luminal portion of sutured gastric incision after 7 days of hyperacidity

Fig. 4 Cross section of the luminal portion of sutured gastric incision after 3 days of hyperacidity

Fig. 5 The edge of sutured gastric incision after 3 days of hyperacidity. The mucosal margins are now widely separated.

Fig. 6 Cross section of sutured gastric incision after 7 days of hyperacidity. $\times 20$.

Fig. 7 Higher power view of one edge of same incision.

Fig. 8 A gastrojejunal anastomosis, virtually healed after 7 days.

Fig. 9 A gastrojejunal anastomosis, still unhealed after 7 days of hyperacidity.

epithelium, but it is protected from gastric juice and is clean and healthy. Six days after operation the incision is completely epithelialized (Fig. 12) and is, to all intents and

purposes, healed. Grossly the incisions appear healed without inflammation.

In striking contrast is the healing of simple incisions in the strongly acid stomach. Fig.

ures 13 to 15 show the progressive deterioration which often occurs. There are ineffectual attempts at proliferation. Mucosal margins may become more widely separated day by day. Figure 16 shows a low power cross-section view of such an incision after 7 days. The line of suture is represented by a trough 7 millimeters in width. It is deep, grossly inflamed and filled with products of deterioration and necrosis. Figure 17 is a photomicrograph of one edge of the trough.

This difference between rapid repair in the normal and imperfect repair or failure to repair in the hyperacid canine stomach is observed also in gastrojejunal anastomoses though here the difference is somewhat less pronounced, probably because excess free acid is partly neutralized by alkaline intestinal contents. Figure 18 shows a gastrojejunal junction which in the presence of normal acidity is almost completely healed after 7 days. In contrast, a gastrojejunal suture in the presence of hyperacidity is shown in Figure 19. The anastomosis remains incompletely healed after 12 days; there is some extension of epithelium from both mucosal margins but the intervening area, partly necrotic, is a poor surface upon which to lay down sheets of new epithelium.

COMMENT

Additional studies were made which show that defects and incisions in the process of healing under normal conditions tend to regress when the dog is given histamine in quantities sufficient to produce large amounts of strongly acid chyme. Conversely unhealthy looking defects and incisions in the hyperacid stomach improve and proceed to heal rapidly when histamine is withdrawn.

It is recognized that hypoproteinemia interferes with healing in the gastrointestinal tract as elsewhere. In these acute experiments an attempt was made to eliminate that factor.

Obviously these effects produced in dogs under artificial experimental conditions should not be applied uncritically to clinical problems but do provoke speculations and suggest practical points for further investigation.

They help perhaps to explain why peptic ulcers persist or enlarge in the presence of excessive amounts of acid but tend to heal

when by one means or another the acidity of the stomach is reduced to or below normal.

They suggest that healing of gastric incisions and anastomoses might take place more normally and rapidly if operations on the hyperacid stomach were followed in selected cases by a few days of antacid medication. They also cast some doubt upon the value of the inner mucosa to-mucosa suture used in gastric surgery—provided hemostasis is secured otherwise.

SUMMARY

Gross and microscopic studies were made of operative defects and sutured incisions in the gastric wall of normal dogs and dogs receiving daily injections in histamine in beeswax.

In approximately 100 normal dogs no spontaneous ulcers were observed. Artificial defects in the gastric wall and lines of incision all showed relatively rapid healing characterized by minimal autodigestion, relatively mild inflammatory reaction, protective and reparative fibrosis, vigorous proliferation of gastric epithelium and early approximation of the mucosal margins.

In dogs with hyperacidity on the contrary spontaneous ulcers, artificial defects and sutured incisions all showed inflammation, necrosis and autodigestion. Fibrosis and granulation tissue were present, but gave the appearance of being unsuccessful barriers to a progressively destructive process. Epithelial regeneration was generally slight or absent and in many instances there was progressive undermining and destruction of marginal gastric mucosa. The severity of the erosive process was roughly proportional to the degree of acidity of samples of fasting gastric contents.

These two conditions of normal repair and of failure to repair in the presence of hyperacidity could be made to change from one to the other by giving or withdrawing histamine.

With due caution in applying experimental results to clinical problems it is suggested that these observations may help to explain the healing or persistence of peptic ulcers.

The question is raised whether operations upon the hyperacid stomach should not be followed by a few days of antacid therapy.

The value of the conventional mucosa to-mucosa suture in gastric surgery is doubtful.

PAINFUL HEELS IN CHILDREN

F. S. R. HUGHES M.D. M.S. F.R.C.S. Oxford England

PAINFUL heels in children are believed by many to be due commonly to an osteochondrosis of the epiphysis of the os calcis. There have been few reports on the histology of the condition. Hass in 1931 found gross disorganization of an epiphysis but Bergmann in 1926 and Frejka in 1927 both noted an absence of any abnormality. It has been suggested that the diagnosis depends on radiological signs but there is no uniformity of opinion as to what may be regarded as the typical x-ray appearances (Table I).

The epiphysis, the epiphyseal line, and the neighboring metaphysis have all been described as showing abnormal roentgenological features. Since it is on the recognition of these latter that the condition is classified as an osteochondrosis or epiphysitis, a large series of roentgenograms were first studied in order to establish the variations in this region in normal children.

THE EPIPHYSIS

Ossification begins in the epiphysis between the 6th and 8th years at multiple centers just below the middle of the posterior aspect of the os calcis. Extension takes place inferiorly superiorly and posteriorly and by the 9th year the epiphysis appears roentgenologically as a cap covering the lower two-thirds of the posterior aspect of the os calcis. During the 10th to the 12th years the remainder of the epiphyseal cartilage ossifies the upper one-third remains as a very thin plate of bone and like the most inferior portion of the epiphysis frequently begins from a separate center. By the 14th year therefore, the epiphysis is roughly C-shaped and extends from the posterior and superior corner of the metaphysis to the posterior part of the plantar surface.

The epiphysis is usually denser than the body of the os calcis; segmentation of the os-

ifying area into two or more segments is not uncommon. The edge of the epiphyseal ossification may be well defined or may be irregular and fluffy. The bone trabeculae run parallel to the surface and are usually but not always well marked.

THE EPIPHYSEAL LINE

During the 9th year the lower lateral edges of the epiphyseal ossification curve forward; this expansion considerably alters the roentgenological appearances because it obscures in this part the clear radiotranslucent line between the epiphysis and the metaphysis. Both the medial and lateral edges of the ossifying plaque can be seen frequently on either side of the posterior edge of the metaphysis of the os calcis. The epiphyseal line is finally entirely obliterated at approximately the 15th to 16th years.

TABLE I—RADIOLOGICAL SIGNS OF EPIPHYSITIS OF THE OS CALCIS

	Roentgen
1. Enlargement of the epiphysis	6, 5, 27
2. Flattening of the epiphysis	2, 16
3. Subchondral bone destruction or absorption of the epiphysis	7
4. Increased density of the shadow of the epiphysis	4, 9, 12, 18
5. Irregularity of the epiphysis	6, 14, 5, 16, 8
6. Fluffy appearance of the epiphysis	7, 9
7. Segmentation of the epiphysis	2, 6, 6, 7, 16, 17, 5
8. Fracture of the epiphysis	
9. Calcareous deposits in the lower part of the epiphysis	6
10. Displacement of the epiphysis up and back	6
11. Abnormal gap between the epiphysis and the body of os calcis	6, 9
12. Considerable cleavage along the epiphyseal line between the affected epiphysis and os calcis	4, 5, 6, 7
13. Unusual irregularity of the adjacent posterior surface of the body of the os calcis	7, 12, 16
14. Areas of rarefaction in the metaphysis	4

From the Wingfield Morris Orthopaedic Hospital, Oxford, England.

Dr Hughes is Travelling Fellow of the National Health and Medical Research Council, Australia.

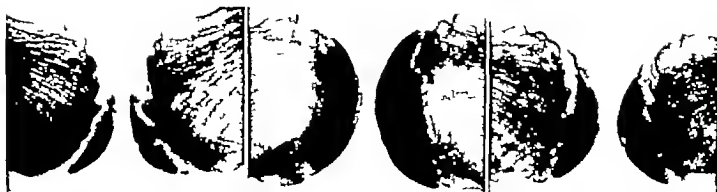


Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 1. D. G. male, 10 years old, right heel.

Fig. 2. Same patient as in Figure 1, left heel.

Fig. 3. M. C. male, 14 years old, right heel.

Fig. 4. Same patient as in Figure 3, left heel.

Fig. 5. R. E. male, 12 years old, right heel.

Fig. 6. Same patient as in Figure 5, left heel.



Fig. 7

Fig. 8

Fig. 9

Fig. 10

Fig. 11

Fig. 12

Fig. 7. D. S. male, 11 years old, right heel.

Fig. 8. Same patient as in Figure 7, left heel.

Fig. 9. J. P., male, 10 years old, right heel.

Fig. 10. Same patient as in Figure 9, left heel.

Fig. 11. M. W. female, 7 years old, right heel.

Fig. 12. Same patient as in Figure 11, left heel.



Fig. 13

Fig. 14

Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 13. P. O. female, 9 years old, right heel.

Fig. 14. Same patient as in Figure 13, left heel.

Fig. 15. P. S. male, 11 years old, right heel.

Fig. 16. Same patient as in Figure 15, left heel.

Fig. 17. R. M. male, 11 years old, left heel.

Fig. 18. C. P. male, 10 years old, left heel.

THE METAPHYSIS

Trabeculae radiating posteriorly and inferiorly from the posterior subastragaloid joint are grouped into a slightly dense band passing to the cortex of the posterior surface and another passing to the posterior and inferior angle. Other trabeculae sweeping posteroinferiorly from near the anterior end of the

plantar surface of the os calcis intersect these former. The posterior surface of the os calcis becomes roughened and the previous sharp line on the roentgenogram is replaced by irregular ridges. These irregularities of the posterior end of the metaphysis together with the overlapping by the edges of the epiphyseal ossification and the arrangement of the bony

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During the 9th year the lower lateral edges of the epiphyseal ossification curve forward this expansion considerably alters the roentgenological appearances because it obscures in this part the clear radiotranslucent line between the epiphysis and the metaphysis. Both the medial and lateral edges of the ossifying plaque can be seen frequently on either side of the posterior edge of the metaphysis of the os calcis. The epiphyseal line is finally entirely obliterated at approximately the 15th to 16th years.

TABLE I—RADIOLOGICAL SIGNS OF EPIPHYSITIS OF THE OS CALCIS

	Reference
Enlargement of the epiphysis	1, 2, 3, 7
Flattening of the epiphysis	10
2 Subchondral bone destruction or absorption of the epiphysis	1, 7
Increased density of the shadow of the epiphysis	4, 11, 12
3 Irregularity of the epiphysis	6, 14, 15
4 Fluffy appearance of the epiphysis	19
7 Segmentation of the epiphysis	3, 4, 5, 11, 12, 15, 16, 17, 18
8 Fracture of the epiphysis	
Calcareous deposits in the lower part of the epiphysis	6
10 Displacement of the epiphysis up and back	6
Abnormal gap between the epiphysis and the body of os calcis	6, 9
Considerable cloudiness along the epiphyseal line between the affected epiphysis and os calcis	4, 5, 16
Unusual irregularity of the adjacent posterior surface of the body of the os calcis	7, 13
14 Areas of rarefaction in the metaphysis	4



Fig. 31



Fig. 32



Fig. 33



Fig. 34



Fig. 35



Fig. 36

Fig. 31 R. B. male, 9 years old, right heel.

Fig. 32 Same patient, left heel (symptomless)

Fig. 33 E. B. male, 11 years old, right heel.

Fig. 34 Same patient as in Figure 33, left heel.

Fig. 35 D. S. male, 10 years old, right heel.

Fig. 36 Same patient as in Figure 35, left heel.



Fig. 37



Fig. 38



Fig. 39

Fig. 37 E. S. male, 13 years old, right heel

Fig. 38 Same patient as in Figure 37, left heel

Fig. 39 D. B. male, 11 years old, right heel



Fig. 40



Fig. 41



Fig. 42

Fig. 40 Same patient as in Figure 39, left heel

Fig. 41 D. O. male, 11 years old, right heel.

Fig. 42 Same patient as in Figure 41, left heel

In favor of this view is the absence of any other apparent cause for the painful heel and the undoubted fact that some films of normal feet display an epiphysis with regular edges. It has been claimed that the age period is characteristic but a painful heel is not uncommon at any age and frequently the underlying etiology is obscure.

There are certain facts, however, that do not support this classification. There is a lack of any histological proof of the disease. After a survey of our films and of those published by other authors it is impossible to agree that these differ in any way from a normal series of films. A follow-up examination revealed no residual anatomical abnormality in the heel clinically or roentgenologically despite the fact that pain sometimes persisted after fusion of the epiphysis and diaphysis.

The epiphysis may be involved in juxta epiphyseal affections of the os calcis (Figs. 43, 44, 45). But in such cases the primary meta-



Fig. 43



Fig. 44



Fig. 45

Figs. 43 and 44. R. G. male 9 years old, painful heel of 6 weeks duration followed by swelling and later sinus formation on medial side. Tuberculosis of os calcis.

Fig. 45 J. D. male 12 years old, painful swollen heel for 6 weeks followed by sinus formation. Tuberculosis of os calcis.

physical lesion can be seen and roentgenologically the epiphyseal damage is restricted to a localized rarefaction and partial avascular necrosis. These appearances are not comparable with those found in painful adolescent heels.

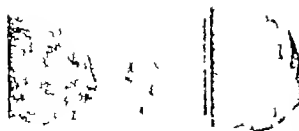


Fig. 1. Normal heel.
Fig. 2. Cloudy epiphyseal line.



Fig. 3. Normal heel.
Fig. 4. Cloudy epiphyseal line.
Fig. 5. Cloudy epiphyseal line.

Fig. 22. Same patient as in Figure 21, left heel.
Fig. 23. R. H. male, 9 years old, right heel.
Fig. 24. Same patient, left heel (symptomatic).

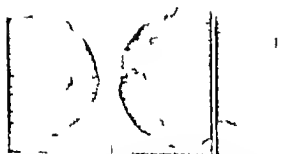


Fig. 6. Normal heel.
Fig. 7. Cloudy epiphyseal line.
Fig. 8. Cloudy epiphyseal line.

Fig. 5. P. H. female, 12 years old, right heel.
Fig. 6. A. W. female, 12 years old, left heel.
Fig. 7. H. F. female, 6 years old, right heel.

Fig. 28. Same patient, left heel (symptomatic).
Fig. 29. A. B. male, 8 years old, right heel.
Fig. 30. Same patient as in Figure 29, left heel.

Fig. 28. Same patient, left heel (symptomatic).
Fig. 29. A. B. male, 8 years old, right heel.
Fig. 30. Same patient as in Figure 29, left heel.

trabeculae result in areas of apparent rarefaction and density of the metaphysis.

ROENTGENOLOGICAL APPEARANCES OF PAINFUL ADOLESCENT HEELS (Figs. 1 to 42)

Since 1939 23 children (17 boys and 6 girls) have sought treatment for painful heels (16 with bilateral symptoms) their ages varied from 6 to 14 years. Pain was intermittent but persistent usually precipitated by exercise and referred to the sides, the back or the inferior aspect of the heel. Apart from slight tenderness in 12 cases, there was a complete absence of physical signs. The roentgenograms of the heels of these patients presented a wide variety of appearances. The epiphysis sometimes seemed enlarged or flattened or irregular or segmented or sometimes presented a mottled or fluffy appearance the epiphyseal line was often cloudy and united the epiphysis to the irregular posterior surface of the body of

the os calcis. When studied in conjunction with the normal series it became clear that none of these x ray films presented pathological features.

DISCUSSION

In 1908 Haglund reported 2 rare but important surgical injuries brought on by violent exercise the first involved the tibial tuberosity and the second the epiphysis of the os calcis which he believed to be fractured or separated from the metaphysis. Sever in 1912 reported 5 cases of apophysitis of the os calcis and compared the condition with Osgood Schlatter's disease. A year later Edmond described irregular epiphyses in 2 boys each aged 13 years. Since then isolated cases and small series have been reported and most authors have followed Sever in classifying the condition as an osteochondrosis which implies an abnormality of the developing epiphysis.



Fig. 31



Fig. 32



Fig. 33



Fig. 34



Fig. 35



Fig. 36

Fig. 31 R. B. male, 9 years old, right heel.

Fig. 32 Same patient, left heel (asymptomatic).

Fig. 33 E. B. male 11 years old, right heel.

Fig. 34 Same patient as in Figure 33, left heel.

Fig. 35 D. S. male, 10 years old, right heel.

Fig. 36 Same patient as in Figure 35, left heel.



Fig. 37



Fig. 38



Fig. 39



Fig. 40



Fig. 41



Fig. 42

Fig. 37 E. S. male, 13 years old, right heel.

Fig. 38 Same patient as in Figure 37, left heel.

Fig. 39 D. B. male 11 years old, right heel.

Fig. 40 Same patient as in Figure 39, left heel.

Fig. 41 D. O. male, 11 years old, right heel.

Fig. 42 Same patient as in Figure 41, left heel.

In favor of this view is the absence of any other apparent cause for the painful heel and the undoubted fact that some films of normal feet display an epiphysis with regular edges. It has been claimed that the age period is characteristic but a painful heel is not uncommon at any age and frequently the underlying etiology is obscure.

There are certain facts, however, that do not support this classification. There is a lack of any histological proof of the disease. After a survey of our films and of those published by other authors it is impossible to agree that these differ in any way from a normal series of films. A follow up examination revealed no residual anatomical abnormality in the heel clinically or roentgenologically despite the fact that pain sometimes persisted after fusion of the epiphysis and diaphysis.

The epiphysis may be involved in juxta-epiphyseal affections of the os calcis (Figs. 43, 44, 45). But in such cases the primary meta-



Fig. 43



Fig. 44



Fig. 45

Figs. 43 and 44. R. G. male, 9 years old, painful heel of 6 weeks' duration followed by swelling and later sinus formation on medial side. Tuberculosis of os calcis.

Fig. 45. J. D., male, 13 years old, painful swollen heel for 6 weeks followed by sinus formation. Tuberculosis of os calcis.

physal lesion can be seen and roentgenologically the epiphyseal damage is restricted to a localized rarefaction and partial avascular necrosis. These appearances are not comparable with those found in painful adolescent heels.

This investigation leads to the conclusion that there is no proof that osteochondrosis or epiphysitis (or apophysitis) is the underlying cause of these adolescent painful heels.

SUMMARY

1. A description has been given of the normal variation in the appearances of the ossifying epiphysis of the os calcis.

The clinical and radiological features of 39 painful heels in children between the ages of 6 and 14 years old are described.

3. It is concluded that there is insufficient proof that osteochondrosis is ever the underlying cause of adolescent painful heels.

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ACUTE PANCREATITIS

A Statistical Review of 307 Established Cases of Acute Pancreatitis

JOHN R. PAXTON M.D. F.A.C.S. and J. HOWARD PAYNE, M.D. Los Angeles, California

THIS study was undertaken with two objectives in mind: first, to improve our diagnostic accuracy by a proper classification, correlation and understanding of the clinical picture; and second, to determine the proper treatment of acute pancreatitis. In addition, this report is justified as a statistical review as it represents a series of cases approximately four times larger than any group previously reported.

We shall neither discuss the etiology of acute pancreatitis nor review the literature.

MATERIAL

An established diagnosis of acute pancreatitis was made in 307 patients admitted to the Los Angeles County General Hospital during the period between January 1933 and January 1946. One hundred fifty-nine cases of the 307 were diagnosed by definite elevation of the blood amylase or urinary diastase; 103 cases were diagnosed at surgery; and 45 were either diagnosed or the diagnosis substantiated at the autopsy table.

CLINICAL PICTURE

Acute pancreatitis may affect all age groups. The youngest in this series was an 11-year-old girl; the oldest, an 86-year-old man. The average male was 41; the average female was 49. The majority of the patients were in the third decade of life.

Acute pancreatitis was more common in the women than in the men. There were 138 males and 169 females.

It has long been our clinical impression that this disease is more prevalent during warm weather. There was a higher incidence of acute pancreatitis during the hot summer months.

The initial pain began immediately after the ingestion of a heavy meal in 76 instances

(25%) a positive point in the history which can be of real diagnostic value. Repeated experiments have shown that pancreatic necrosis is more readily produced soon after the ingestion of a heavy meal—presumably when the pancreas is active producing digestive substances.

An unusually large percentage of these patients had previous similar—but less severe—attacks. These episodes were generally mild and of short duration, subsiding within 24 to 48 hours. There is universal agreement that these episodes represent a mild form of the disease and are commonly referred to as edematous pancreatitis or acute interstitial pancreatitis. The patient, however, may refer to them as indigestion, gastritis, or dyspepsia. It is not uncommon for a fatal attack to be preceded by several mild attacks. A past history typical of acute pancreatitis was elicited in 43 per cent of our patients. An additional 18 per cent had had some previous gastrointestinal difficulty suggesting the mild form of the disease. Therefore, 61 per cent of the 307 patients probably had had previous attacks.

Only recently has the rôle of alcoholism in the pathogenesis of acute pancreatitis received any attention. Fifty-five patients (18%) were admitted intoxicated or were recuperating from a recent alcoholic bout. We are certain that had more of the alcoholics been studied for acute pancreatitis, a greater number would have been included in this report.

SYMPTOMS

TABLE I—SYMPTOMS

	Number of cases	Per cent
Pain	290	94.5
Nausea	291	94.6
Vomiting	158	51.0

The 3 predominating symptoms in the acute phase of the disease are (1) pain, (2) nausea, and (3) vomiting. Of the 307 patients, 290 had abdominal pain. Sixteen were admitted

From the Department of Surgery of the University of Southern California School of Medicine and the Los Angeles County General Hospital. Presented to the sectional meeting of the American College of Surgeons at Los Angeles, California, April 8, 1946.

This investigation leads to the conclusion that there is no proof that osteochondrosis or epiphysitis (or apophysitis) is the underlying cause of these adolescent painful heels.

SUMMARY

A description has been given of the normal variation in the appearances of the ossifying epiphysis of the os calcis.

The clinical and radiological features of 39 painful heels in children between the ages of 6 and 14 years old are described.

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An unusually large percentage of these patients had previous similar—but less severe—attacks. These episodes were generally mild and of short duration subsiding within 24 to 48 hours. There is universal agreement that these episodes represent a mild form of the disease and are commonly referred to as edematous pancreatitis or acute interstitial pancreatitis. The patient, however may refer to them as indigestion, gastritis, or dyspepsia. It is not uncommon for a fatal attack to be preceded by several mild attacks. A past history typical of acute pancreatitis was elicited in 43 per cent of our patients. An additional 18 per cent had had some previous gastrointestinal difficulty suggesting the mild form of the disease. Therefore 61 per cent of the 307 patients probably had had previous attacks.

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SYMPTOMS

TABLE 1 — SYMPTOMS

	Number of cases	Per cent
Pain	290	94.5
Nausea	291	94.6
Vomiting	258	84.0

The 3 predominating symptoms in the acute phase of the disease are (1) pain (2) nausea and (3) vomiting. Of the 307 patients, 290 had abdominal pain. Sixteen were admitted

in coma with no history. One patient with epidemic parotitis had no abdominal pain. This patient developed persistent nausea and vomiting during the acute phase of mumps. Both the blood amylase and urinary diastase were significantly elevated. A clinical diagnosis was made of mild acute pancreatitis secondary to the parotitis.

The pain was epigastric in location in 114 cases, epigastric radiating to the back in 122 cases, epigastric in origin becoming generalized, in 38 cases. However of this group with upper abdominal pain, there were 39 cases in which the pain originated in the right upper quadrant and radiated through to the back, simulating acute cholecystitis. On examination unilateral or bilateral flank tenderness was found. Flank pain and tenderness is of definite diagnostic significance in acute pancreatitis.

Seventeen patients presented an unusual pattern for acute pancreatitis in that the pain began suprapubically and radiated to one or both flanks. This distribution of pain in any acute condition within the abdomen is not particularly common. When this syndrome presents itself the blood amylase and urinary diastase should always be determined.

Eighty-four per cent of the 307 patients had nausea and vomiting. Reflex vomiting appears early and is generally persistent. Later in the course of the disease the vomiting is variable dependent upon the amount of ileus present or the degree of duodenal obstruction from the enlarging pancreas. The absence of nausea and vomiting was not sufficiently characteristic in any syndrome to have statistical significance.

From a clinical standpoint the disease usually falls into one of five groups. In *Group 1* is seen the standard textbook description of acute pancreatitis—an elderly obese stolid individual who has eaten a large meal preceded by several highballs. A few hours later he is seized with excruciating upper abdominal pain followed immediately by nausea and profuse vomiting. Generally he is in profound shock with cyanotic mottled skin and diffuse abdominal rigidity and tenderness. Peristalsis is infrequent or absent. Later he may have ecchymosis of the flanks or the umbilicus. Death

ensues within 24 to 36 hours with a terminal hyperpyrexia (105 to 106 degrees F). The patient who simulates acute coronary occlusion is included in this group. Four patients had substernal pain with radiation to the epigastrium. In 2 other cases the pain was localized in the precordium. These 6 patients were admitted with a diagnosis of acute coronary occlusion. In 3 of these fat necrosis was observed in the left pleura and the pericardium at the post mortem.

Group 2 simulates acute cholecystitis. The onset is usually sudden with moderately severe epigastric or right upper quadrant pain. The pain often radiates through to the back and is followed at once by nausea and persistent vomiting. In the past, the patient has experienced similar seizures, but jaundice is not often reported. Thirty-nine patients in this series gave such a history. On admission in 33 of the 39 an erroneous diagnosis of acute cholecystitis was made.

Group 3 imitates mechanical small intestinal obstruction. These patients are seemingly so characteristic that a diagnosis of mechanical small intestinal obstruction is made in the admitting room. However there is no apparent etiology—such as hernia or abdominal scar—for the obstruction. Any patient who appears to have an intestinal obstruction without obvious etiology should have a blood and urinary diastatic activity determined before surgery is contemplated. In 26 patients in this series first a diagnosis of intestinal obstruction was made—later of acute pancreatitis.

Group 4 resembles acute alcoholism with acute gastritis. Included in this category are those patients that are thought to have perforated a peptic ulcer. Patients in this group often are admitted either intoxicated or they give a history of having been on a recent, prolonged, alcoholic spree. Subsequently they develop abdominal pain, nausea, and vomiting. However these symptoms may be minimal. The slight degree of abdominal rigidity often leads to the mistaken diagnosis of a slow leaking peptic ulcer. The known high frequency of acute pancreatitis during or following acute alcoholism compels us to determine the diastatic activity of the blood and urine as a routine measure.

Group 5 comprises those patients who on admission have a mass either in the epigastrium or the left upper quadrant. Approximately 3 to 4 weeks prior to admission they had acute pancreatitis. A pancreatic abscess, a pseudocyst or inflammatory exudate remained as a tender mass. Their initial symptoms may fall into any of the four groups described.

ASSOCIATED SYMPTOMS

TABLE II.—ASSOCIATED SYMPTOMS

	Number of cases	Per cent
Diarrhea	22	71
Bloody diarrhea	4	45
Hematemesis	10	31
Hypertension	60	95

Gastrointestinal hemorrhage. An extremely interesting symptom which may confuse the clinical diagnosis is gastrointestinal hemorrhage. Twenty four of our patients had massive gastrointestinal hemorrhage—14 times as a bloody diarrhea and 10 times as a bloody vomitus. At the postmortem examination numerous areas of hemorrhagic ulceration were observed in the mucosa of the stomach, small intestine and colon. After a cursory examination of the voluminous literature on pancreatitis we have not found any reference to these hemorrhagic areas of ulceration. Further study is now in progress to establish the cause and exact nature of these hemorrhagic areas and will be reported at a later date.

It has been demonstrated that the tryptic action of the pancreatic enzymes can produce vascular necrosis and hemorrhage in all tissues of the body. This may be the cause of the ulceration (Fig 1).

Diarrhea. Diarrhea may be a misleading symptom in the differential diagnosis of acute pancreatitis. It was present in 22 of our 307 cases. The diarrhea is caused by the initial increase in peristaltic movements produced by the irritation of the autonomic nerve supply to the intestine. Probably the absence of pancreatic enzymes in the intestine is a contributing factor. Constipation however is more common than diarrhea.

Clinical hypertension. Twenty per cent had clinical hypertension. It is significant that the



Fig. 1. Segment of ileum showing hemorrhagic ulceration of the mucosa.

average age of this group of patients (41 years for males—49 years for females) is not in the decade when hypertension would be expected. This observation varies from the widespread belief that profound shock is generally present. As can be seen from Table III, only 11.7 per cent were in shock. Two hundred thirty-seven cases (78%) had no clinical evidence of shock.

TABLE III.—DEGREE OF SHOCK

	Number of cases	Per cent
None	237	78.0
Moderate	19	6.2
Severe	36	11.7

The degree of shock principally depends on the pathology present. None will deny the presence of irreversible hypotension in the patient with widespread destruction of the pancreas. In the early stages, this reduction of blood pressure represents a neurovascular reaction excited by pain and tissue destruction. Later it merges gradually into secondary shock without an interval of partial recovery and precedes death in a state of severe peripheral vascular collapse. The state of peripheral vascular collapse is the probable explanation of the peculiar cyanosis exhibited by the patient. This is not to be confused with the brownish discoloration of the flanks (Grey Turner sign) or the slate blue color of the umbilicus (Cullen's sign). These are produced by an entirely different mechanism.

ASSOCIATED PATHOLOGY

Listed in Table IV are the various pathological lesions which were associated with these cases of acute pancreatitis.

TABLE IV — PATHOLOGY

	Number of cases	Per cent
Biliary tract disease	5	40.7
Alcoholism	35	18.0
Intestinal	3	
Appendicitis	3	
Intestinal	2	
Other	1	
Unrelated pathology	7	38.0

Each condition has been listed as probable etiological factors.

DIAGNOSIS

Table V lists the admitting diagnoses made in the series.

TABLE V — ADMITTING DIAGNOSIS

	Number of cases	Per cent
Pancreatitis	50	48.8
Cholecystitis	33	0.8
Perforated ulcer	50	6.3
Intestinal obstruction	26	8.5
Appendicitis		3.9
Gastrointestinal hemorrhage	8	.6
Alcoholism	7	3
Coronary occlusion	6	9
Miscellaneous	5	4.9

Acute pancreatitis may be suggested by the symptoms and findings but we must depend on the laboratory to establish the clinical diagnosis. The various laboratory aids in the diagnosis are (1) elevated blood amylase (2) elevated urinary diastase (3) depressed blood calcium (4) roentgenogram of the abdomen (5) changes in the electrocardiogram (6) elevated blood sugar (7) sugar in the urine.

DIASTATIC ACTIVITY

A definite elevation in the blood amylase usually occurs within the first 24 hours. Frequently a patient with acute pancreatitis has a normal serum amylase during the first 8 to 12 hours. This fact must be considered in correlating the laboratory findings with the stage of the disease. The blood amylase remains elevated 24 to 72 hours depending upon the severity of the disease. It usually returns to normal before the clinical subsidence of the disease. Here again the time element must be considered in establishing the presence of acute pancreatitis. The urinary diastase usually becomes elevated 12 to 24 hours later than the elevation of the blood amylase. It remains

elevated 24 hours or more longer than the elevated amylase. This however is not constant. The variability in the time of elevation of both the amylase and diastase is impressive. It is recommended that both the blood amylase and urinary diastase be done simultaneously in any suspected case of acute pancreatitis regardless of the elapse of time since the onset of the disease.

It must be remembered that the blood and urinary diastatic levels may be normal in cases that have widespread destruction of the pancreas. Apparently the gland is completely destroyed and the enzymes in the serum drop to normal or subnormal levels.

We use a rapid method of determination which was devised by Doctor Albert Chaney of the Los Angeles County General Hospital biochemical laboratory. It is a modification of the Somogyi method. This method has proved very satisfactory.

BLOOD CALCIUM

The blood calcium may become depressed due to the utilization of the ionizable calcium. Pancreatic lipase acts upon the fats splitting them into glycerol and free fatty acids. Calcium soaps are formed by a combination of the free fatty acids and the ionizable calcium. These calcium soaps have been observed many times at surgery and necropsy—also in roentgenograms of the abdomen. This depression of the calcium may be severe enough to produce clinical tetany. This has been reported by Doctors Edmondson and Berne and Doctors Edmondson and Fields.

ROENTGENOGRAM

In the later stage of the disease, the x ray picture of the abdomen frequently shows a segmental type of ileus which may involve the stomach, small intestine or colon. The transverse colon exhibits this selective segmental ileus more often than the rest of the bowel. One hundred twenty five of the 307 patients had emergency scout films of the abdomen—82 cases (68%) revealed a segmental type of ileus. This segmental distribution of gas is not pathognomonic of acute pancreatitis roentgenographically but it certainly suggests the diagnosis.

PAXTON PAYNE ACUTE PANCREATITIS

ELECTROCARDIOGRAM

A small group of patients with acute pancreatitis will exhibit changes in the electrocardiogram. Although these changes are non-specific, they are suggestive enough for the diagnosis to be considered. They are thought to be caused by a low calcium level. Positive correlation has been made between the blood calcium level and electrocardiographic changes. Ralph E. Homann has published a critical study of the electrocardiographic changes.

GLYCOSURIA AND HYPERGLYCEMIA

Some patients with acute pancreatitis spill sugar into their urine. They also have an increase in the blood sugar level. During the early years of this study, urinalyses were not done in all patients. Therefore, it would be a statistical fallacy to include part of the group giving the incidence of sugar. The elevated blood sugar level usually was high in the patients who had glycosuria. In 1 case, it was 1500 milligrams per 100 cubic centimeters of blood. In this group, there was no preceding history suggestive of diabetes. One must assume that the glycosuria is secondary to the acute pancreatitis. In the literature, there are several articles pointing out that diabetes may result from acute pancreatitis. This we have seen many times.

TREATMENT

The treatment of choice in uncomplicated acute pancreatitis is not surgical. Conservative treatment is recommended because of the results obtained. The objective of the treatment is to place the pancreas at rest. Pancreatic activity may be decreased by the following measures: (1) continuous gastrointestinal suction, (2) adequate parenteral fluids, (3) regular use of morphine sulfate, and (4) regular doses of atropine sulfate.

Continuous gastrointestinal suction is of extreme importance. By preventing the acid gastric secretions from entering the duodenum, the hormonal stimulation of the pancreas is reduced to a minimum. In addition, acute gastric dilatation is prevented and the ileus which develops is successfully treated.

The fluid and caloric requirements are met by administering 3000 to 4000 cubic centime-

ters of 5 per cent glucose solutions daily. No insulin is given unless it is necessary in the treatment of associated diabetes.

Regular injections of morphine sulfate (gr $\frac{1}{6}$ to gr $\frac{1}{4}$) are used to relieve the severe pain of the pancreatic necrosis and to place the gastrointestinal tract at rest. Remarkable relief from pain is obtained by a procaine block of the paravertebral sympathetic ganglia (T4-9). It is also known that the sympathetic supply excites external pancreatic secretion. A splanchnic block with single injection probably would be preferable.

Atropine sulfate is given in large doses (gr $\frac{1}{15}$ to gr $\frac{1}{100}$) every 3 to 4 hours. This effort is designed primarily not to relax the sphincter of Oddi but to suppress the vagus mechanism. Stimulation of the vagus produces a concentrated pancreatic juice rich in enzymes.

Reverse Trendelenburg position favors respiration without the hazard of obstructing the return venous flow.

One additional measure that may favorably alter the course of acute pancreatitis is the use of x-ray therapy. This is given during the acute phase of the disease. An analysis of our experience with this therapy is to be reported at a later date by Doctor Leo Levi of the Department of Radiology, Los Angeles County General Hospital.

Patients with acute pancreatitis on the treatment outlined may show rapid clinical improvement. Other than a slight elevation in temperature, the patients have no symptoms or findings of acute pancreatitis. Diastatic activity is within the normal range. If the gastrointestinal suction is discontinued and the oral feeding started, an exacerbation of the disease results. It is our policy to continue the intensive conservative treatment until the temperature has been normal for a minimum of 48 hours. The febrile response is an important guide in determining when treatment can safely be discontinued.

A review of the literature concerning the treatment of acute pancreatitis indicates a predominance of opinion in favor of immediate surgical interference. It has long been our clinical impression that the mortality in those patients with acute pancreatitis who are operated

upon—irrespective of the procedure performed—is definitely greater than the mortality in those that are not operated upon. The following report on the results substantiate our impression.

Table VI indicates the total number of cases as 307 with 102 deaths—a mortality of 33.3 per cent. Of the 307 patients, 103 were operated upon with 46 deaths—a mortality of 44.7 per cent. In the group that were not operated upon there were 204 patients with 56 deaths—a mortality of 27.5 per cent.

MORTALITY

TABLE VI—MORTALITY

	Number of cases	Deaths	Per cent
Operated upon	3	46	44.7
Not operated upon	204	56	27.5
Moribund	6	6	100
Not operated upon less moribund	88	40	3
Total	307	102	33.3

However of these 56 deaths in patients who were not operated upon 16 patients were admitted in *extremis*. Therefore they should not be classified in either category insofar as the effects of any specific therapy is concerned. If this moribund group of 16 cases is deducted from the 204 patients treated without surgery 188 cases remain with 40 deaths—a 21.3 per cent mortality.

In the group operated upon during the acute phase of the disease Table VII indicates the various types of operations performed, the number of cases, and the deaths. These data statistically have no significance except to point out that irrespective of the procedure the end results are poor.

TABLE VII—OPERATIONS

	Number of cases	Deaths	Per cent
Exploration	53	24	45.3
Cholecystectomy		9	42.8
Drainage of pancreas		5	30.0
Cholecystectomy	8	3	37.5
Cholecystectomy and pancreatic drainage	5		100.0
Cyst drained	1		100
Cholecystectomy and common duct drainage	5	3	60.0

A study that we have started which is far from complete but which we wish to mention at this time is an operative procedure designed to prevent recurrence. The surgery referred

to is section of the vagus nerves. Division of the vagus nerves will interrupt the two important stimuli to the pancreas. The hormonal stimuli will be reduced to a minimum by decreasing the acid secretion of the stomach. The direct stimulation to the pancreas will be diminished greatly. To our knowledge, only 2 patients have had vagus sections for this disease. One was done on our service at the Los Angeles County General Hospital, and the other in a private hospital by another member of our staff (Doctor A. C. Pattison). A detailed report of these cases will be published later.

SUMMARY AND CONCLUSIONS

1 We have presented a critical review of 307 established cases of acute pancreatitis in patients admitted to the Los Angeles County General Hospital during the past 13 years.

2 Five clinical syndromes of acute pancreatitis are described. Attention is directed to several important signs and symptoms. These are (a) massive gastrointestinal hemorrhage (b) diarrhea (c) segmental ileus seen on the emergency scout film (d) alcoholism, (e) the electrocardiographic changes (f) absence of shock, and (g) presence of hypertension.

3 Blood amylase and urinary diastase determinations if correlated with the stage of the disease are the most important aids in the diagnosis. It is recommended that both the blood amylase and urinary diastase be done simultaneously in any suspected case of acute pancreatitis.

4 The febrile response is the important guide in determining when treatment can safely be discontinued. Premature discontinuation of active therapy will result in reactivation of the disease.

5 There was an over-all mortality of 33.3 per cent. The patients that were operated upon as emergencies had a mortality of 44.7 per cent. In the group that was not operated upon, the mortality was 21.3 per cent indicating that conservative therapy is superior to any operative procedure during the active phase of acute pancreatitis. This we believe is equally true in either the acute edematous pancreatitis or the hemorrhagic variety.

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Study of each patient included a careful inquiry into the nature of the injury the extent of the motor and sensory dysfunction the onset, character, and constancy of the pain, as well as factors which either caused exacerbation or amelioration of symptoms. Each patient was given a complete neurological examination and most of them underwent a careful evaluation of the vasomotor status. Skin temperature studies were carried out in the major oscillometric studies in some.

Sympathetic blocks were performed by the introduction of 0.5 per cent procaine with adrenalin into the paravertebral space between the first and second dorsals in the case of lesions of the upper extremity between the first and second lumbar in lesions of the lower extremity. The efficacy of the injection in blocking the sympathetic pathways was established by such observations as the presence of a Horner's syndrome, cessation of sweating and vasodilation. Sympathetic ganglionectomy for the lower extremities was accomplished through an anterior extraperitoneal approach under spinal anesthesia. The upper extremities were denervated by the posterior preganglionic operation of Smithwick performed under intratracheal anesthesia. There were no deaths and no serious complications. A single patient was treated by paravertebral alcohol block.

RESULT

Fifty-seven patients were treated by permanent sympathetic interruption. Twenty-one responded well to single or repeated procaine sympathetic blocks. Two patients noted gradual steady improvement following neurolysis with eventual relief of all symptoms. Two patients obtained relief of pain following excision of a neuroma and neurorrhaphy. In this regard it is of interest that 11 patients who subsequently obtained relief of pain from sympathetic procaine blocks had noted no relief after neurolysis and 3 had noted no relief after neurolysis and neurorrhaphy. Similarly 13 patients who were benefited greatly by sympathetic block had observed no change in pain following neurolysis nor had 4 others following neurolysis and neurorrhaphy. In 3 there was a spontaneous subsidence of symptoms. The outcome in 5 patients is unknown.

One of the 5 was subsequently treated by sympathectomy and 1 was apparently improving under a course of intermittent venous occlusion when last heard from.

THE EFFECT OF PROCAINE ANESTHESIA

One hundred and eighty-one sympathetic blocks were performed in 83 patients. Excluded are a number of blocks carried out upon some of the patients before they came under our care. Seven patients in the series received no sympathetic anesthesia. Two were patients in whom sympathectomy was felt advisable under any circumstances because of poor circulation in a limb in which there was a large subcutaneously ruptured aneurysm. In another patient sympathectomy was also felt advisable because of extensive nerve damage from aneurysmorrhaphy with ligation of the brachial artery. Two were patients who obtained relief following neurolysis or neurorrhaphy and two who were rapidly making a spontaneous recovery at the time of the original examination.

In 5 instances the injection was ineffectual in anesthetizing the sympathetic chain and in relieving pain. In each case other injections were effectual in blocking the sympathetic nerves and in relieving pain. In a few cases relief of pain was incomplete. In some of these the burning pain was relieved completely and the residual discomfort consisted of a persistence of other painful sensations such as tingling or aching. One patient noted very little alteration of pain. He will be referred to more fully later. In the other instances the entire pain was dramatically relieved. In all of medical practice no results are more sudden or spectacular. Before the injection the patient would be in agonizing pain guarding his injured extremity with zealous care reluctant to have it examined even after painstaking assurance that every effort would be taken to perform the examination in the gentlest manner. He would be hesitant to have the block itself carried out because he felt that his capacity to suffer prevented him from enduring any more discomfort even the prick of a needle which he had often heard from other sufferers might lead the way to cure. As soon as the injection

TABLE I.—DURATION OF RELIEF OF PAIN WITH REPEATED PROCAINE SYMPATHETIC BLOCKS IN THOSE PATIENTS SUBSEQUENTLY TREATED BY SYMPATHECTOMY WHO HAD MORE THAN ONE BLOCK BEFORE OPERATION

Case N	Duration of relief of pain in hours				
	1st block	2nd block	3rd block	4th block	5th block
	1				
1	1				
2	20				
3					
4					
	3		1		
	4				
14			1		
5	3	1			
16	6 days	days			
27					
8			1		
	1	1	1		
20					
	1	1	1		
	6				
24					
5					
26					
7	1	1			
28					
29	days	day			
30					
	6	6	6		
32		7.5			

was completed his careworn face would assume an expression of extreme satisfaction, the beads of perspiration would disappear and he would settle back with a sigh of relief to enjoy his respite. Adequate examination which had before been difficult or impossible was now easily performed.

The duration of relief varied. In some instances it lasted only for the period of the anesthesia, while in others it lasted for hours, days or even permanently. In a few the exact duration of the relief of pain is not recorded. Seventy-eight blocks were followed by relief of pain for 2 hours or more. In the remainder the relief lasted only for the length of the sympathetic anesthesia, 1½ hours or less. It was a very striking finding that in some instances the duration of relief was the same after each block or grew progressively shorter (Table I). All patients who had such a response were treated by sympathectomy except for the occasional patient who appeared to be getting well spontaneously or was relieved by excision of a neuroma and suture. In some patients on the other hand each successive block was followed by a progressively longer period of relief (Table II). These patients in general tended to obtain permanent relief from such treatment. It was a striking finding that in the first group the initial injection tended to be prolonged beyond the period of sympathetic anesthesia. For example, of the 31 cases recorded in Table I in which multiple blocks were carried out before sympathectomy the original block gave relief of 1½ hours or less in 14 or 42.5 per cent while the same brief cessation of pain was noted in 21 of the remaining 23 patients (91.3 per cent) who had a single sympathetic anesthesia before sympathectomy. On the other hand, all of the 21 patients listed in Table II who obtained permanent relief from one or more procaine blocks were freed from pain for prolonged periods by the first injection except for 3 in whom it was felt the sympathetic anesthesia was incomplete. It is also evident from the data in Table I that when relief from the first injection was limited to the period of sympathetic anesthesia subsequent blocks generally gave no more prolonged respite from pain. When each successive block resulted in a shorter period of relief no permanent alleviation of pain was achieved by further injections (Table I). On the contrary those patients who were eventually rendered free of pain by procaine blocks generally noted progressively longer periods of freedom from pain following each successive injection.

TABLE II—DATA CONCERNING PATIENTS PERMANENTLY BENEFITED BY PROCAINE SYMPATHETIC BLOCKS

Case No.	Nerves injured	Degree of causalgia	Duration of causalgia in mos.	Duration of relief following sympathetic blocks (d)					Remarks
				1	nd	3rd	4th	5th	
	Radial	+++							
	Sciatic	+++	4	P					
3	Brachial plexus	++++	4	P*					Complete relief except for occasional slight dull ache in thumb
4	Sciatic	++++	5	P			P		
5	Sciatic	++	5	P					Very slight residual pain subsequently relieved by excision of neuroma and neurolysis
6	Sciatic	++	7	P					
7	Ulnar	++	9						
8	Sciatic	++++			P				
9	Sciatic	+++		MI	II	P			Each of sat two blocks resulted in lasting diminution of pain
10	Median radial, ulnar	++	35						Complete relief except for occasional mild twinges of pain
11	Tibial	++++							pain for 2 mos. occasional slight pain thereafter
12	Brachial plexus	++++	4D	P	SD	P			
13	Sciatic	++	4						
14	Median ulnar	++++	4	D					Only mild pain after sat block
15	Brachial plexus	++	7	P	S	SD	P		95% relief
16	Median, ulnar	++			S	4D	P		Complete relief except for occasional slight "hacking" sensation
17	Radial	++++	4	P					
18	Sciatic	++	5	P					
19	Median and internal plantar	++++	6						
20	Median, radial	+	45	P					
21	Sciatic	++++	45	P					
22	Sciatic	++	5	P*	4D	P			Complete relief 4 hrs., then returns of very mild pain. Gradual improvement in pain after 1 week
23	Sciatic	++	5	P					No pain for 9 days. 1 yr slight residual
24	Sciatic	++	5	P					Very light residual

(*) Symbols D—days, M—months, P—permanent. (†) Where no symbol is used the numeral designates hours.

Of the 83 patients in whom sympathetic anesthesia was induced one time or more 21 obtained permanent relief. The data concerning these patients are recorded in Table II. Ten were cases of causalgia of the upper extremity and 11 of the lower. The severity varied in 7 cases it was very severe in 4 moderate in 9 mild¹ and in 1 trivial. The pain was

In this communication the degree of causalgia has been classified in general as severe, moderate, or mild. Perhaps others would have designated these degrees of pain as excruciating, severe and moderate. We have used these terms in a comparative way, we do not mean to imply that these classified as "mild" had inconsequential pain but rather that the pain, distressing as it was, was mild in comparison with that presently suffered by those with more severe grades of causalgia.

of from 2 to 9 months duration or an average of 4 21 months. Ten required only 1 injection the remainder 2 3 4 or 5 injections. In some of the latter cases the pain was never as severe after the first injection. In 9 patients there was a persistence of very slight discomfort. In 1 of them all pain disappeared 12 weeks later and another lost his residual discomfort subsequently after excision of a neuroma and nerve repair. In all of the patients the residual pain was trivial in nature and often consisted only of intermittent mild paresthesias. Follow up observations extended over a number of months in all patients and

for more than a year in some. Altogether the results of sympathetic blocks in these 21 patients must be considered excellent.

RESULTS FOLLOWING SYMPATHECTOMY

Thirty four patients were treated by permanent interruption of the sympathetic pathways in the upper extremity 33 by operation one by alcoholic infiltration (Table III). In 10 cases the brachial plexus was injured in 10 the median radial and ulnar nerves, in 5 the median and ulnar in 4 the median in 3 the ulnar in 1 the radial, and in 1 the radial and ulnar. In 28 cases of the 34 there was injury to the median and in 29 to the ulnar nerve. In 3 cases the median paralysis was apparently complete and in 5 cases the ulnar paralysis appeared complete. In 11 instances there was associated thrombosis or posttraumatic operative ligation of the major arteries, in 8 involving the brachial in 1 each the subclavian the axillary and the radial and ulnar arteries in combination. In 2 additional patients the brachial artery had been ligated during operative treatment of a brachial aneurysm while in 2 others there was an aneurysm or arteriovenous fistula, one affecting the axillary artery and the other involving the brachial artery and vein. The causalgia was of extreme degree in 22 cases, of moderate severity in 7 and was mild in 4. The duration of pain at the time of operation ranged from 17 to 13 months an average of 47 months. In 25 patients the pain was completely relieved and in 6 others the residual discomfort was inconsequential. In these 31 patients (91 per cent) the result may be said to be excellent. In 2 the result was good in spite of incomplete relief of pain and in only 1 was the operation a failure. These last 3 cases will be presented more fully subsequently. All patients were followed for several months after operation and not a few for a year or more. None had any return of pain or increase in any residual discomfort.

Twenty three patients were treated by lumbar sympathetic ganglionectomy. The sciatic nerve was injured in 19 patients once in conjunction with the saphenous nerve. In 1 patient the saphenous nerve was injured, in 2 the peroneal and in 1 the tibial. Altogether

the tibial nerve was partially paralyzed in 15 patients, and apparently completely paralyzed in 3. There was apparent complete peroneal paralysis in 10 patients, partial paralysis in 2. The degree of pain was extreme in 3 patients, moderate in 8 and mild in 12. The duration of pain at the time of operation varied from 3 weeks to 14 months, an average of 5.28 months. The first second third and fourth lumbar ganglia were excised in 4 cases the first, second, and third in 5 the second and third in 11 and the second third, and fourth in 3. Relief of pain was complete in 11 patients and in an additional 4 patients an excellent result was obtained the residual discomfort being trivial. In 3 patients there was mild persistence of pain while 5 had relief only of about half their original pain. These 8 cases with only good or fair results will be discussed more fully subsequently. It is of interest that the result was excellent in 9 of the 11 cases with extreme or moderate pain and in 6 of the 12 cases with mild causalgia. The result was excellent in 7 of the 9 patients in whom the ganglionectomy included the first ganglion, and in 8 of the 14 in whom the highest ganglion resected was the second.

Of the 57 patients treated by operation (or alcohol injection) an excellent result was obtained in 46 or 81 per cent. In the remainder the relief of pain was satisfactory in all save 1 (Case 22 Table III) although suggestion may have played a part in the cure of 1 (Case 23 Table IV). Altogether the results were excellent in 37 of the 40 patients in whom the pain was moderate or extreme (92.5 per cent) and in 10 of the 17 in whom the pain was mild (58.8 per cent). In the 43 cases in which sympathetic denervation of the entire extremity was complete, an excellent result was obtained in 38 (88.4 per cent) and in 8 of 14 (57.1 per cent) in which the denervation was incomplete (cases of causalgia of the lower extremity in which the first lumbar ganglion was left intact). It would appear profitable to present in more detail the cases in which the result of operation was only good, fair or poor.

CASE 4 (Table III). This patient was a nurse anesthetist who had sustained a striking blow to her hand, forearm and arm in a struggle with a patient

TABLE III.—RESULTS OF DORSAL SYMPATHECTOMY IN CAUSALGIA OF UPPER EXTREMITY

Case No.	Nerves injured	Severity of causalgia	Duration of causalgia	Result of treatment
	Brachial plexus	+++++	4	Relief
	Median, radial, ulnar	+++	7	Relief
3	Median	+++	7	Relief
4	Ulnar	++	6	60% to 80% relief
5	Median	+++++	3	Relief
6	Median, radial, ulnar	+++++	6	Relief
7	Median, radial, ulnar	+++++	5	Relief
8	Brachial plexus	+++++	3	90% relief
9	Median, radial, ulnar	+++	4 1/2	Relief
10	Median, ulnar	+++++	7 1/2	Relief
11	Median, radial, ulnar	+++++	5	90% relief. Burning disappeared and aching off and on. Mild throbbing
12	Median, radial, ulnar	+++++	5	Relief
13	Median, ulnar	+++++	3	Relief
14	Median, ulnar	+++++	2	Relief
15	Median, radial, ulnar	+++++	7	Relief
16	Brachial plexus	+++++	3	Relief
17	Median, radial, ulnar	+++	3	Relief
18	Median, ulnar	+++++	4	25% relief. Burning disappeared. Less throbbing. Persistence of tingling and aching
19	Brachial plexus	+++++	2	Relief
20	Median, radial, ulnar	++	6	Relief
21	Median, radial, ulnar	++	5	Relief
22	Brachial plexus	+++++	4	5% relief
23	Radial, ulnar	+++++	4	Relief
24	Brachial plexus	+++++	4	Relief
25	Median, ulnar	+++++	5	Relief
26	Brachial plexus	+++++		Relief
27	Ulnar	+++	6	Relief
28	Radial	+++	4	Relief
29	Median	+++++		Relief
30	Ulnar	+++++	4	Relief
31	Median	++	6 1/2	90% relief
32	Brachial plexus	+++++	2 1/2	90% relief
33	Brachial plexus	++	3	90% relief. Occasional / intermittent shooting pains persisted
34	Brachial plexus	+++++		90% relief

*This patient was treated by alcoholic block of sympathetic chain.

during a difficult anesthetic induction. Thereafter progressively increasing signs of ulnar paralysis ensued. Six months after injury the ulnar nerve was explored at the elbow and found to be diffusely thinned and scarred. It was transplanted anteriorly. Little or no improvement in nerve function followed. Four months after the injury she had begun to have intense, constant burning pain in the hand largely

limited to the ulnar area. This was not influenced by the transplantation of the ulnar nerve. Six months after onset of pain a sympathetic block gave complete relief for 4 1/2 hours. Another block performed 3 days later gave similar relief for a slightly shorter period. Three days following this injection a preganglionic dorsal sympathectomy was performed. The patient was relatively comfortable

TABLE IV—RESULTS OF LUMBAR SYMPATHECTOMY IN CAUSALGIA OF LOWER EXTREMITY

Case No.	Nerves injured	Severity of causalgia	Duration of causalgia	Causalgia scored	Result of treatment
	Sciatic	++		3	Relief
	Saphenous	+++	5	3	Relief
	Sciatic	++++			75% relief. Burning disappeared. Slight mild tingling and aching
4	Sciatic	+++	6	1, 3	Relief
5	Sciatic	++			90% relief
6	Sciatic	+++	6	3	Relief
7	Sciatic	+++	6	3	Relief
8	Sciatic	++++		6	Relief
9	Sciatic	+++		6	Relief
	Sciatic	++		3	75% relief. Burning disappeared
	Sciatic	++	5	3	Some residual tingling
	Sciatic	++		3	90% relief
13	Sciatic	+++	5	1, 2, 4	Relief
14	Sciatic, Saphenous	++		1, 3	Relief
15	Sciatic	++		3, 4	90% relief
16	Sciatic	++		4, 5	90% relief
17	Sciatic	++		1, 3	90% relief
18	Peroneal	++		3	90% relief
19	Sciatic	+++	7.5	3, 4	90% relief
20	Tibial	++		3	90-95% relief
21	Sciatic	++++		3	90% relief
	Superficial peroneal	++		3	Relief
22	Sciatic	+++		3	90% relief. Residual pain at night for 3 weeks. Disappeared with reassurance

thereafter and required no narcotics or sedatives but occasionally had mild pain. She estimated that she had from 60 to 80 per cent relief. No explanation is offered for the continued mild pain.

CASE 18 (Table III). This patient sustained a shell fragment injury of his forearm. The median and ulnar nerves and questionably the radial, were badly damaged; there was a compound comminuted fracture of the radius and ulna; the radial artery was severed and had to be ligated; the ulnar artery was thrombosed. Two days after injury intense constant pain began. He complained of burning, tingling, pins and needles sensations, throbbing, and aching of the entire forearm and hand. Four months later a sympathetic block gave relief for 1 hour. A few days later dorsal sympathectomy was carried out. On questioning the patient he estimated that only about one-third of the pain was relieved. He no longer had any burning pain, however the throbbing was less and his residual discomfort consisted chiefly of tingling and aching. His circulation was improved and radial nerve function which had apparently been absent before was now found to be intact. He required no sedation and his appearance was one of comfort in contrast to one of abject misery before

operation. This case was atypical in the wide extent of the area in which pain was felt. The fractures were infected and ununited and part of the remaining pain was due perhaps to movement at the fracture sites. Altogether the result was good.

CASE 22 (Table III). The patient had sustained in a motorcycle accident avulsion of the trunks of his brachial plexus, thrombosis of the subclavian artery, acromioclavicular separation and fracture of the humerus. The circulation was precarious and he developed ischemic ulcers of the hand. Immediately after injury he complained of extreme burning, aching, mashing, and squeezing pain in his paralyzed forearm and hand and this continued unabated. Four months after injury an effectual sympathetic block gave relief of pain about the elbow and in the proximal forearm but none in the distal portions of the extremity. In spite of this poor response sympathectomy was performed the following day in the hope that it would provide relief, because there appeared no hope of saving the limb if the circulation could not be improved and because there was some question that the nerve paralysis might be ischemic in nature. The pain disappeared from the proximal third of the forearm but was as severe as ever distally.

Subsequent lysis of the plexus brought no relief nor did alcohol injection of the plexus. It is understood that the entire nenromatous plexus was subsequently excised but the eventual outcome is unknown to us. The patient was atypical in the wide extent of the area in which pain was felt. The result of the sympathectomy was a failure.

CASE 3 (Table IV) This patient was wounded in the thigh and popliteal space and sustained also a partial injury of the tibial component of the sciatic nerve. Severe constant, burning pain in the toes and sole of the foot began immediately. Five sympathetic injections were performed overseas and none altered the pain. It is not known whether sympathetic anesthesia was obtained. Four months after injury a sympathetic block resulted in cessation of pain for 1 hour. Three days later a second and third lumbar ganglionectomy was performed. The burning pain disappeared but he now complained of mild tingling and aching. In contrast to his preoperative state during which he was always in great pain and on the verge of tears, he now appeared happy and comfortable. Five weeks later a neurolysis was carried out with relief of the residual pain. It would appear that the tingling and aching sensations not complained of during the period of excruciating burning came to consciousness with relief from the burning. The result was considered good.

CASE 5 (Table IV) This patient noted immediate onset of mild burning and tingling in the sole and toes following a thigh injury in which the sciatic nerve was traumatized. There was evidence of a complete peroneal and partial tibial paralysis. Three sympathetic blocks performed 2½ months after injury gave relief on each occasion for about half an hour. Excision of a neuroma and partial neurotomy a few days later were without effect upon the pain. Six weeks afterward the second and third sympathetic ganglia were excised. The patient continued to complain of some pain but appeared more comfortable and slept well without narcotics, which had been required previously. That he was making the most of any residual pain was evidenced by these observations as well as by the fact that sterile subcutaneous injections of water now gave relief of pain although they had not done so before operation. He continued to improve. The result was considered good. In this case certain neuropsychiatric features may have been at play in the persistence of some complaints.

CASE 11 (Table IV) The patient had noted the onset of constant mild burning and tingling in the sole and toes 2 weeks following a wound of the thigh with injury of the sciatic nerve. Two sympathetic blocks performed a month later gave relief for 1½ hours on each occasion. A month afterward the second and third sympathetic ganglia were excised. There was no further burning but slight intermittent tingling persisted especially when the patient walked. This discomfort became progressively less. Nerve function improved steadily and when seen 3 months later he was free of all discomfort. The result was

considered good. This is an instance of relief of the major pain with persistence of some paresthesias.

CASE 12 (Table IV) Two weeks after an injury to the thigh in which the sciatic nerve was badly damaged, the patient began to have constant knife-like, tingling shock-like aching and burning pains in the ankle and sole of the foot. Though he complained bitterly observation suggested that his pain was mild in comparison with that of most of those with severe causalgia. Cold packs caused exacerbation of pain. A month after injury two sympathetic blocks gave relief for 1 hour on each occasion. A few days later an alcohol injection was made with production of only partial sympathetic anesthesia and with only slight reduction in pain. Sympathectomy was deferred until after neurolysis had been carried out and was then performed somewhat reluctantly because certain features of the case appeared atypical, especially the multiplicity of the types of pain and the lack of preponderance of burning. He had noted no improvement after lysis of the nerve which was badly scarred over such a long extent that excision and suture appeared impossible. Sweating observations after sympathectomy suggested that denervation of the lower extremity was complete. Most of the pain disappeared after sympathectomy and there was little left except a very annoying tingling which was felt especially in the peroneal distribution. He was able to take physiotherapy to walk with a brace and his edema disappeared. He slept poorly, however, complained a great deal and inquired about the feasibility of cordotomy. He was transferred to another hospital and when seen about 2 years later stated that the pain had disappeared after a femoral perianthelium sympathectomy had been performed. This would appear to be an atypical case in which some residual paresthesias were particularly disturbing to a patient with a low pain threshold. It is difficult to understand how perianthelium stripping could have been effective in a sympathetomized limb.

CASE 15 (Table IV) This patient had sustained a clinically complete sciatic injury from a wound of the thigh. He began immediately to have persistent mild burning stinging tingling throbbing and shooting pains throughout the entire foot. Four months after injury three sympathetic blocks were performed. There was relief of pain for 2, 1, and ¼ of an hour following these injections. A few days later a second, third, and fourth sympathetic ganglionectomy was carried out. Milder intermittent pains of the same character persisted although he felt considerably improved and was able to put weight on his foot and to sleep without sedation both impossible before operation. The result was felt to be good. One might speculate whether excision of the first lumbar ganglion as well would have resulted in complete cessation of pain.

CASE 16 (Table IV) The patient noted onset of constant, mild burning and tingling pains in the dorsum of the foot and in the toes immediately following a thigh injury in which he sustained a mild

damage to both components of the sciatic nerve. Nine months after injury he was given three sympathetic blocks, each of which resulted in cessation of pain for a 6 hour period. A month later the first second, and third sympathetic ganglia were removed. He estimated that half his pain was gone. The pain at rest largely disappeared but some mild burning and tingling was felt when he stood or walked. There was no longer any hyperesthesia. He continued to improve. The result was felt to be good.

CASE 20 (Table IV) After an unknown interval following wounds to his thigh and leg the patient developed mild burning pain in the foot. The injury had produced an aneurysm of the popliteal artery which had ruptured subcutaneously before admission. The tense swelling of the popliteal area caused such severe pain as to outweigh entirely the mild pain in the foot. Neurological changes consisted only of hypesthesia of the dorsum and sole of the foot with areas of marked hyperesthesia. Because of poor collateral circulation and the possibility of forced early operation, the second and third sympathetic ganglia were excised 3 months after injury. The pain decreased and the collateral circulation was improved. Three weeks after sympathectomy aneurysmorrhaphy was carried out. The result of sympathectomy in this patient was considered fair. The burning pain was less after ganglionectomy and was limited to the distal portions of the foot. The hyperesthesia largely disappeared.

CASE 23 (Table IV) The patient noted onset of burning pain in the sole of the foot a few days after a thigh injury which produced a large aneurysm of the profunda femoral artery. Signs of sciatic injury were limited to hyperesthesia of the plantar surface of the foot. Seven weeks after injury aneurysmorrhaphy was carried out. This effected no change in the pain. A few days later a sympathetic block was performed. This gave relief of pain for 3 hours. A second block the following day gave relief for 45 minutes. Three days later the second and third ganglia were excised. He complained of very mild pain off and on. Because certain features suggested an underlying hypochondriasis, suggestive persuasion was instituted. By the end of 3 months he was almost entirely free of pain. Certainly some relief can be attributed to sympathectomy but it is likely that suggestion played a rôle in the eventual excellent result.

DISCUSSION

As might be anticipated with a disorder so painful, so persistent and so debilitating as causalgia, almost every conceivable kind of medical physiotherapeutic, and surgical approach which offered any promise of cure has been tried. Some did no harm other than to allow the disorder to persist indefinitely by failing to relieve pain with resultant dysfunction of the extremity wearing down of morale

and not infrequently narcotic addiction. Others such as section and resuture of the injured nerve root section and cordotomy not only were often attended by failure but were unnecessarily destructive procedures. As experience has increased it has become evident that interruption of the sympathetic pathways constitutes the most reliable and safe method of treatment. Our present study confirms this concept. Although numerous successes following periarthral sympathectomy were reported some years ago direct attack upon the ganglionated sympathetic chain appears to produce more reliable results in causalgia as in other disorders amenable to sympathectomy.

In the present series of cases there were encountered only 4 instances of relief of pain following neurolysis or neurorrhaphy. In contrast 31 patients who subsequently noted cessation of pain following sympathetic blocks or sympathectomy had experienced no relief whatsoever after neurolysis or neurorrhaphy. This confirms the general unreliability of operative attack upon the injured nerve. In 15 patients who later had relief of pain from sympathectomy or sympathetic blocks, previous ligation and division of the injured artery had been performed without alteration of symptoms. Two other patients who had relief from sympathetic interruption had noted no alleviation following arterial stripping. These observations confirm the unquestionable superiority of operations upon or proximal injections of the ganglionated chain to periarthral sympathectomy. Only 3 patients were noted to undergo spontaneous subsidence of symptoms even though most of the patients were observed months and some a year or more after the onset of causalgia.

The results of sympathectomy were excellent. Over 80 per cent had complete lasting relief of pain or were left with only trivial discomfort. The result in the remainder was satisfactory in all save one the patients being sufficiently improved so that no further treatment was necessary. In addition to diminution of pain the local hyperesthesia disappeared entirely or in large part in all of them. In one patient it is not unlikely that encouragement and suggestion may have played a part

in the cure effected. The single case of complete failure was an atypical case with complete neuromatous involvement of the entire brachial plexus.

In those cases in which there was incomplete relief of pain several considerations must be taken into account. In the first place observations have been recently recorded (1,9) suggesting that it may be necessary in some instances to sympathectomize the site of injury as well as the area to which the pain is referred. Four cases have been recorded in which pain was relieved after excision of the first lumbar ganglion after incomplete relief following excision of the second and third ganglia, and 2 cases in which relief was obtained after excision of the twelfth thoracic or the eleventh and twelfth thoracic ganglia after incomplete relief had been obtained following excision of the lumbar chain. It is possible that inadequate sympathetic denervation may have been responsible for the incomplete relief in a few of our patients. Such a theory might be considered, for example, in Cases 3, 5, 15, 16 and 20 in Table IV in all of them there was persistence of mild pain and in all of them the first lumbar ganglion was left intact. Unfortunately such an explanation is hypothetical since subsequent procaine blocks or operative excision of the first ganglion were not performed because the residual discomfort was so inconsequential. Indeed in one of the cases (Case 5) it appeared fairly evident that certain neuropsychiatric factors were at play. This reasoning is not applicable in Cases 4 and 18 in Table III nor in Cases 12 and 16 in Table IV since in these patients the area of injury as well as the area of pain was fully denervated.

Without evoking any underlying hypochondriacal or other neuropsychiatric basis it seems likely that the persistence of mild paresthesias after relief of the principal burning pain is understandable as an increase in conscious appreciation of trivial discomfort to a level not felt formerly when more severe pain of other character was present. Paresthesias of this nature are commonly enough seen in injuries and diseases of nerves unassociated with causalgia. This explanation may serve for the incompleteness of relief in such cases as 18

Table III, and 3 and 11 Table IV. Finally recognizing full well the hazard of implying that failure of complete cure from any procedure is due to attendant neuropsychiatric factors, we feel that such factors do occasionally contribute to persistence of pain. This appeared to be true in Cases 5, 12, and 23. Indeed, 2 of these 3 patients continued to improve with reassurance, while the third obtained relief of residual discomfort from perianal stripping in an already sympathectomized extremity.

Though permanent relief of pain in causalgia from sympathetic procaine blocks has been reported some observers are in doubt that such cures can be effected in true causalgia. In 5 recent papers (1, 2, 3, 6, 9) in which a total of approximately 200 sympathectomies are reported, one author did not mention cures following sympathetic blocks alone, two noted cures in a few patients but stated that repeated blocks generally produced no permanent effect, another stated that repeated blocks were ineffectual in providing complete permanent relief, while the fifth observed prompt or delayed relief of pain of sufficient degree to make unnecessary other treatment in 45 of 91 patients. In our experience single or repeated procaine blocks effected a very satisfactory alleviation of symptoms in 21 of 83 patients in whom one or more injections were made. Our studies confirm the findings we have observed in other vasomotor disorders that there is little likelihood of obtaining lasting improvement from any number of injections if the good response to the first is limited to the period of sympathetic anesthesia. Even more reliably a decrease in the duration of relief with successive blocks suggests that a permanent cure cannot be effected by procaine blocks alone. On the other hand, if the initial injection gives relief prolonged beyond the period of sympathetic anesthesia or if successive blocks result in increasing periods of relief one should be encouraged to try to effect a permanent cure by means of a series of procaine injections.

SUMMARY

1. Sympathectomy is a safe and generally reliable method of treatment in causalgia.

2 Failures are extremely rare and incomplete cures uncommon. It is suggested that incomplete relief may result from failure to denervate the site of injury, as well as the area to which pain is referred from persistence of paresthesias which are observed in cases of nerve injury without causalgia, and from perpetuation by some underlying neuropsychiatric factors.

3 Sympathetic procaine blocks are not infrequently effectual in relieving the pain of causalgia. There is little likelihood that repeated procaine blocks will bring about permanent relief if the first injection causes cessation of pain only for the duration of the anesthesia or if successive blocks give relief for decreasing periods of time. One should be encouraged to proceed with a course of procaine blocks if the initial injection gives relief

prolonged beyond the period of anesthesia or if successive blocks result in increasing periods of freedom from pain.

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EVALUATION OF TREATMENT OF SLIPPING OF THE CAPITAL FEMORAL EPIPHYSIS

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IN order to evaluate the treatment of the slipping of the upper femoral epiphysis during its various stages the histories and roentgenograms of 169 patients who had been seen at the University of Iowa Hospitals from 1932 to 1947 were reviewed. Seventy three patients were selected because of good clinical and roentgenographic follow up. Fifty four of these had unilateral and 19 had bilateral slipped epiphyses making a total of 92 hips. The average follow up time for this selected group was 2 years and 10 months.

The patients were classified into 5 groups as follows

1 Preslipping stage—5 patients 1 with bilateral preslipping

2 Acute slipping or fracture separation of upper femoral epiphysis—19 patients, 1 with bilateral acute slipping

3 Chronic slipping with minimal to moderate displacement—31 patients, 4 with bilateral chronic slipping

4 Chronic slipping with marked displacement—21 patients 5 with bilateral chronic slipping

5 Residual deformity of femoral head and neck due to old slipped epiphysis—4 patients 1 with old bilateral slipping

Seven patients with bilateral slipping of the femoral head had different types of slipping in their 2 hips and were included as patients with unilateral slipping in 2 different groups. Therefore they are listed twice in this group classification. Twelve patients had bilateral slipping of similar type and are listed only once.

The age of the patients at the onset of symptoms varied from 11 to 17 years in boys with an average of 14 1 years and from 10 to 14 years in girls with an average of 12 1 years. One boy with bilateral slipping was 20 years of age and 1 girl with unilateral slipping was

25 years of age when they first complained of hip pain. Both patients had deficiency of their pituitary growth factor and the closure of all the epiphyses was greatly delayed. The right hip was involved in 43 patients and the left hip was involved in 49 patients. Fifty six patients, or 76 7 per cent, were male and 17 patients, or 23 3 per cent were female.

The end results were graded as follows

1 Perfect result—normal or almost normal hip joint and femoral neck contours full range of motion and no limp or pain

2 Moderate distortion of the femoral neck restriction of internal rotation only and no limp or pain

3 Marked distortion of the femoral neck, no internal rotation motion and moderate limitation of other ranges of motion, no or mild limp on exertion, and no pain

4 Marked distortion of the femoral head and neck marked limitation of hip motion in all directions limp and pain

PRESLIPPING STAGE

Five patients 1 with bilateral hip symptoms belonged to this group. They usually complained of weakness of the leg and limped on exertion. Pain usually did not appear until a few weeks later and then it was present only when the patient stood or walked for long periods of time. This pain was localized in the hip or radiated into the adductor region of the thigh. One patient never complained of any pain.

On physical examination the most consistent finding was limitation of internal rotation motion. One patient had hip pain and limp but no limitation of motion. Another patient had marked limitation of active hip motion in all directions. Limitation of internal rotation appeared before any actual anatomical displacement had occurred. This limitation of motion could be due to spasm of the obturator internus and gemellus muscles, which are in

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close proximity to the posterior capsule of the hip joint. Howarth found a certain degree of synovitis in the hip joint in all the patients with preslipping on whose hip an exploratory operation was performed.

The roentgenographic examination showed generalized bone atrophy of minor degree of the bicipelvis and the upper femur on the affected side. This generalized bone atrophy was present only in the patients who had limped or did not use the affected leg at least for a few weeks, and was interpreted by us as disuse atrophy. Widening irregularity and fuzziness of the upper femoral epiphyseal line were constant findings. No disalignment between the femoral head and neck could be detected either on the anteroposterior or on the lateral roentgenograms (Fig. 1).

Result of treatment of the preslipping stage

a. Two patients with unilateral preslipping were given crutches for only a few weeks. One patient had pain and moderate limp for 6 months but slipping of the epiphysis never occurred (result 1). The other patient sustained a fracture separation of the epiphysis 7 months after onset of symptoms. The femoral head did not die, but the joint space became very narrow 1 year after the acute slipping resulting in marked limitation of motion in this hip (result 4).

b. Two patients with unilateral preslipping and 1 patient with bilateral preslipping were treated by drilling and pinning. This was done by inserting two threaded Steinmann pins from the outer aspect of the upper femur through the femoral neck into the femoral head. One of these patients was a 20 year old boy who had had a suprascapular cyst which caused hypopituitarism and which delayed closure of all the epiphyses. The suprascapular cyst had been removed. The results obtained in these hips were excellent (result, 4 hips, 1) (Fig. 1 d e).

Comment. The preslipping stage represents a potential danger as was demonstrated by one of our patients who sustained an acute separation of the epiphysis 7 months after the onset of symptoms. When the syndrome of preslipping is diagnosed drilling and pinning of the affected upper femoral epiphysis should be done without delay.

ACUTE SLIPPING OR FRACTURE SEPARATION OF THE UPPER FEMORAL EPIPHYSIS

Nineteen patients, one with bilateral fracture separation of the upper femoral epiphysis, belonged to this group. The patients usually gave a history of mild weakness, limp or pain on exertion in the affected limb a few weeks or months duration before the acute slipping took place. The acute slipping was brought about by direct trauma to the greater trochanter or by a minor fall. In one patient the acute slipping took place while turning over in bed.

Immediately after the trauma the patient had very acute pain in the hip and was unable to move the leg. Weight bearing was impossible. Upon physical examination it was found that the leg was in complete outward rotation and any attempted motion of the leg was extremely painful. There was marked spasm of all hip muscles. The affected limb was from $\frac{1}{2}$ to 3 centimeters shorter than the normal one.

The acute slipping was followed by a period of 2 to 3 weeks of absolute weight bearing intolerance. The acute pain and muscle spasm decreased gradually during these weeks, and some degree of free hip motion reappeared. However the hip remained moderately painful and in outward rotation. Osteoarthritis of the hip joint developed within a few months, with flexion adduction, and external rotation contractures (Fig. 2).

Anteroposterior and lateral roentgenograms revealed the femoral neck to be completely separated from the femoral head and displaced forward and upward. The contours of the displaced femoral neck were sharply demarcated (Figs. 3, 4, and 5).

Result of treatment of the acute slipping stage.

a. Three patients with unilateral acute slipping were seen from 4 to 22 months after the acute episode. They had had no treatment. The femoral head had not died in any of these 3 hips. However marginal osteophytes, subchondral cysts, and narrow joint space were evident on the roentgenograms taken on admission (Fig. 2). All patients had pain and limp (results—3 hips, 4).

b. Eight patients with unilateral acute slipping seen from 1 to 21 days after the acute

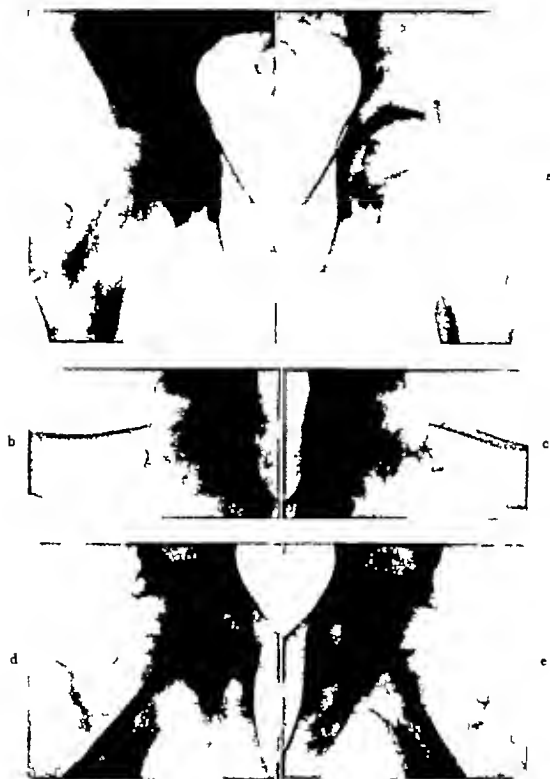


Fig. 1. Preslipping stage in the left hip in a 12 year old boy. The patient had lumped on the left leg for 5 weeks, but had had no pain. The left lower had been in traction for 2 weeks prior to admission. On examination, the left hip was painless and freely movable, except for complete limitation of inward rotation. The right hip was normal. Drilling of the left upper femoral epiphysis followed by the insertion of one threaded Steinmann pin was performed in October 1943. The same procedure was done on the right, 1 year later because symptoms of preslipping developed in the right hip. The patient was last seen in May

1947 and both hips were found to be symptomless and had normal range of motion. a, Direct print of a roentgenogram shows generalized bone atrophy of the left pelvic bone and upper femur. The left upper femoral epiphyseal line is wide and fuzzy. b and c, Lateral roentgenograms demonstrate that slipping of the femoral head has not occurred, but the epiphyseal line is wider and more irregular in the left than in the right. d and e, Roentgenograms taken 2 1/4 years later. The epiphyseal plates are ossified. No slipping ever occurred between the femoral head and neck.

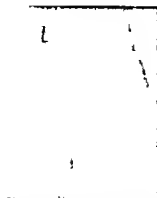


Fig. 2. Roentgenogram of the right hip of a 6-year-old boy taken $\frac{1}{2}$ years after acute fracture separation of the right upper femoral epiphysis. This was not reduced. A plaster hip spica was applied 1 month later. The patient had persistent pain in the right hip and had limited ab- and adduction of the hip joint. Range of hip motion was very limited. Production of osteophytes at the upper margin of the hip joint is seen. The femoral head did not become necrotic.

episode were treated by closed reduction followed by the application of a plaster hip spica. A closed reduction was also attempted in 1 patient seen 3 months after the trauma.

Complete reduction of the fracture separation was obtained in 2 patients, seen 2 and 3 weeks after the acute slipping. The entire femoral head became necrotic in both instances and it took from 2 to 3 years to become completely resubstituted by new bone. The femoral head flattened and the hip joint space became very irregular (results—1 hip 3, 1 hip 4).



Fig. 3. a, Roentgenogram of the left hip of a 7-year-old boy who sustained a fracture separation of upper femoral epiphysis in July, 1938. The leg was manipulated 3 weeks later but only an incomplete reduction was obtained. Plaster hip spica was applied. b, Four months after manipulation the femoral head appeared necrotic. An area of absorption of the dead bone is seen in the inferior medial aspect of the head. In April, 1939, drilling operation of the left femoral neck and head was performed. Roentgenogram taken 4 months after the drilling opera-

tion shows that the absorption of the necrotic bone was now taking place both from the inner and outer aspects of the femoral head. Evidently new blood vessels had penetrated through the drill holes into the femoral head. c, Roentgenogram taken 5 years after the fracture separation. The femoral head is seen to be flat and deformed and areas of dead bone are still visible in its center. The left hip was shown to be in marked flexion and adduction contracture and there was very limited range of motion present.

Partial reduction of the fracture separation was obtained in 4 patients seen from 1 to 21 days after the acute slipping. The femoral head became completely necrotic in 2 hips and partially necrotic in the remaining 2 (results—1 hip 2, 2 hips, 3, 1 hip 4) (Fig. 3).

No reduction was obtained in 2 patients seen 2 weeks and 3 months after the acute slipping. Necrosis did not appear in the femoral head of the first patient (result—3). Complete necrosis occurred in the latter patient (result—4).

c. Five patients with unilateral acute slipping seen 1 day to 2 weeks after the acute episode were treated by closed reduction, followed by drilling and pinning of the upper femoral epiphysis.

The reduction was performed in 4 patients under anesthesia by gradual traction and internal rotation and mild abduction of the affected leg on an orthopedic table. Abrupt maneuvers were not employed. When the anteroposterior and lateral roentgenograms showed complete reduction a small incision was made over the lateral aspect of the upper femoral shaft. A long drill was inserted several times through the femoral neck into the femoral head in order to perforate the epiphyseal line. Two to three threaded Steinmann pins were then inserted into the femoral neck and head to immobilize the reduced head. A plaster hip spica was applied for 4 to 6 weeks.



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Fig 4 a, Roentgenogram of a 12 year old boy who had a fracture separation of the right upper femoral epiphysis. This was reduced 4 days later by progressive traction and inward rotation on the fracture table with the patient under anesthesia. After the reduction the femoral neck and head were drilled and two threaded Steinmann pins were inserted. b and c, Roentgenograms taken 3 months after reduction show that the fracture displacement had been



slightly overreduced. The bone of the femoral head shows areas of irregular density. d, Roentgenogram taken 7 months subsequently shows the femoral head of uniform density and solidly fused to the neck. The patient is symptomless.

Some areas of increased bone density in the femoral head were seen on the roentgenograms taken a few months after reduction in 3 of these hips. These areas disappeared promptly and no damage to the joint or change in contour of the femoral head occurred. The bone of the femoral head of the fourth patient was always of uniform density. A normal hip was the result in each of these 4 patients (result—4 hips 1) (Fig 4).

The fifth patient seen 1 day after the trauma was submitted to repeated Leadbetter maneuvers until a perfect reduction was obtained. The femoral neck and head were then drilled and pinned. The femoral head became necrotic and deformed and the joint surface was very irregular (result—1 hip 4).

d. An 11 year old girl was seen 2 months after the acute episode. The roentgenograms showed a viable femoral head. The hip was exposed by an anterior approach and the epiphyseal plate was drilled. An intertrochanteric osteotomy was performed under direct vision and the distal femoral fragment was displaced medially under the femoral head. The result was excellent (result—1 hip 1) (Fig 5).

A 12 year old girl was seen 4 weeks after the acute episode. The roentgenograms showed that the femoral head was viable. An open reduction of the fracture separation of the epiphysis was performed with a wedge resection of the femoral neck. The entire femoral head became necrotic. The end result was a deformed and painful hip joint (result—1 hip 4).

c. Two 15 year old boys were seen 7 weeks and 1 year, respectively after the acute episode. In the first patient the femoral head was found to be nonviable and was removed at the time of the operation. A fascial hip arthroplasty was performed implanting the femoral neck into the acetabulum. The second patient complained of pain and marked limitation of motion in the hip. A fascial arthroplasty was performed. The end results were not satisfactory because both patients had some hip pain, limp, and limitation of motion in the affected hip (result—2 hips 4).

Comment. It is obvious from these statistics that a successful reduction of the acute slipping of the upper femoral epiphysis can be obtained if the patient is seen during the first 2 weeks following the accident. The reduction



Fig 5 a, Roentgenogram of the left hip of an 11 year old girl who had a fracture separation of the upper femoral epiphysis 3 months prior to admission. An intertrochanteric osteotomy was performed through an anterior incision and the epiphysis was drilled. b, Roentgenogram taken 5 months after surgery. The patient was symptomless.



a

b



d

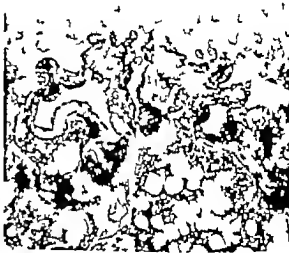


Fig. 11. (1) Roentgenograms of the left hip of a 4 year old child (see histology in the text). a, Normal hip joint. b, Roentgenogram of the same hip taken a year later. The joint space is narrow. All slipping was demonstrated at the time on the left view. c, Roentgenogram taken 4

months later shows narrow joint space and irregular subchondral ossification. d, Roentgenogram taken a year after arthroplasty. e, Photomicrograph showing that most of the joint cartilage of the femoral head had been substituted by fibrocartilage. Loose connective tissue is seen attached to the joint surface and represents one of the numerous fibrous adhesions found at surgery. f, Irregular ossification in the deep layers of the joint cartilage of the femoral head.

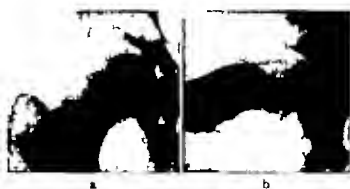
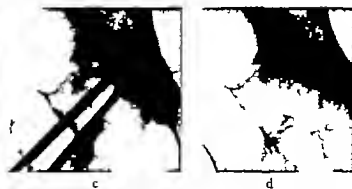


Fig 7 a and b, Roentgenograms of the right hip of a 14 year old girl who had a mild degree of slipping of the upper femoral epiphysis. This slipping was treated by



drilling and pinning. Very marked stiffening of the hip and narrowing of the hip joint space occurred a few months after surgery c and d, Described in text.

the blood supply to the femoral head. The statistics on the open reduction show a high percentage of necrosis of the femoral head which entails a poor result. Very good results may be obtained by the drilling of the epiphysis followed by an intertrochanteric osteotomy performed under direct vision through an anterior approach to the hip joint with medial displacement of the distal femoral fragment under the head.

CHRONIC SLIPPING WITH MINIMAL TO MODERATE DISPLACEMENT

Thirty-one patients, 4 with bilateral chronic slipping, belonged to this group. The clinical symptoms of these patients were quite similar to those observed in the preslipping stage. However, weakness of the leg, limp on exertion, and pain were usually of intermittent character. Periods of several weeks or months duration of complete freedom from symptoms were frequently seen, alternated with periods of pain. Apparently the slipping occurred by repeated displacements of small degree rather than by a continuous and slow process. Several patients of this group had no complaints.

The physical examination revealed marked limitation or absence of internal rotation in all the patients of this group. Some limitation of abduction was also noted in many of them.

The roentgenograms revealed findings similar to those seen in the preslipping stage. In addition, however, the femoral neck appeared widened and shortened and the shadow cast by the epiphyseal plate was very wide and irregular due mostly to anteversion of the femoral neck. The displacement of the femo-

ral head posteriorly over the neck can be first detected only in the lateral roentgenograms and later on in the anteroposterior views as well (Fig 7 a and b).

Results of treatment of the chronic slipping stage with minimal to moderate displacement

a Six boys with unilateral chronic slipping were seen from 5 months to 2 years after the onset of symptoms. They were given crutches and advised to practice limited weight bearing on the affected leg for a few weeks or months. The slipping did not progress in any of these patients and the end results were good (results—3 hips 1 3 hips 2).

b Eight patients with unilateral chronic slipping were seen 1 to 8 months after onset of symptoms. A plaster hip spica was applied from 3 to 8 months and no or limited weight bearing was allowed. No further slipping occurred in any of these patients. The epiphyseal plate became obliterated from 5 to 12 months after onset of treatment, and very good end results were obtained (results—5 hips 1 3 hips 2).

c Thirteen patients, 1 with bilateral chronic slipping, were seen 1 to 15 months after onset of symptoms. They were treated by drilling and pinning of the upper femoral epiphysis (6) as were the patients of the preslipping group. No attempts were made to reduce the displacement. Plaster cast immobilization was not used after the operation. The epiphyseal plate became obliterated from 4 to 12 months after treatment. The results were excellent (results—11 hips 1 2 hips 2).

A 14 year old girl seen 7 months after the onset of symptoms was treated in the same

manner. The roentgenograms revealed no increase of the femoral head but the joint space became very narrow within a few months after treatment and the hip motion practically disappeared. This condition will be discussed later (result—4) (Fig. 7).

d. A 17 year old boy seen 18 months after onset of symptoms was treated by drilling of the upper femoral epiphysis and intertrochanteric osteotomy. The osteotomy was done to correct an external rotation contracture and was performed through a lateral approach. The distal femoral fragment was not displaced under the femoral head. The result was not very satisfactory (result—1 hip 3).

e. A 13 year old girl, seen 10 months after onset of symptoms, was treated by drilling of the upper femoral epiphysis. No internal fixation was used. Four months later the roentgenograms showed the epiphysis to be closed and no further displacement had occurred (result—1 hip 3).

Comment. In the patients with chronic slipping of minimal to moderate degree good results were obtained by simple rest from weight bearing for a few months or by prolonged immobilization in plaster hip spica (5) or by drilling and pinning of the upper femoral epiphysis. However in the patients treated by rest or plaster cast immobilization an average of 9 months was required before the epiphyseal plate became obliterated. On the other hand in the group of patients treated by drilling and pinning the average time for epiphyseal closure was 6 months. Furthermore the fixation of the femoral head to the neck by pinning offers assurance against further slipping and against acute slipping. The patient may be allowed complete freedom of motion following the operation. Weight bearing on the affected leg can be started 1 month after surgery.

CHRONIC SLIPPING WITH MARKED DISPLACEMENT

Twenty-one patients five with bilateral chronic slipping belonged to this group. The clinical symptoms of these patients were similar to those seen in the chronic slipping with minimal to moderate displacement although

the limitation of internal rotation and abduction of the hip were more pronounced in patients of this group. The roentgenograms showed the displacement to be more pronounced than in the patients of the preceding group.

Results of treatment of chronic slipping with marked displacement. a. Nine patients with unilateral chronic slipping of marked degree, seen 1 month to 3 years after onset of symptoms, were treated by a short period of bed rest or with crutches and no weight bearing of the affected leg for a few weeks. To this group belonged the case of a 25 year old girl with marked hypopituitarism and delayed closure of all epiphyses (results—7 hips, 3 1 hips 4).

b. Three patients one with bilateral chronic slipping of marked degree, seen 9 to 12 months after onset of symptoms were treated by plaster cast immobilization for 4 to 6 months. No further slipping was noted in the hip of any of these patients. The results were satisfactory because the pain disappeared in all the patients so treated (results—4 hips, 3).

c. Two patients, seen 18 and 24 months after onset of symptoms were treated by manipulation of the hip under anesthesia, followed by plaster cast immobilization. No reduction of the slipping was obtained in either case and no necrosis of the femoral head was observed. Two years after the manipulation it was noted in one of these patients that the joint space was very narrow and there was great restriction of all hip motions. This case will be discussed later (results—2 hips, 4).

d. Three patients with unilateral chronic slipping of marked degree seen 6 to 12 months after onset of symptoms, were treated by drilling and pinning of the upper femoral epiphysis. One of these patients was a 20 year old boy who had hypopituitarism with delayed epiphyseal closure. His other hip was treated for a preexisting. The result in each of these patients was satisfactory although they had moderate residual limitation of hip motion (result—3 hips, 3).

e. Eight patients with unilateral chronic slipping of marked degree seen 6 months to 4 years after onset of symptoms, were treated by different types of osteotomies.

facial arthroplasty was performed in May 1939. At the operation the articular cartilage of the femoral head was found to be eroded and pitted. This condition was most pronounced in the region of the fovea centralis. Numerous fibrous adhesions were present and probably were the cause of the marked limitation of motion. Microscopic examination revealed hyperemia of the synovia which contained a few chronic inflammatory cells. Irregular enchondral ossification was present in the deep layers of the joint cartilage covering the femoral head. Some degree of this same process was present in the cartilage covering the acetabular cavity. The joint cartilage was thinned because of ossification of its deeper layers. The marrow spaces of the subchondral bone contained essentially normal marrow which was devoid of inflammatory cells (Fig. 6, e and f).

The patient was last seen in February 1947 and had fairly good range of useful motion in both hips. The joint space of the right hip was wide but the contours of the femoral head were irregular.

CASE 2. A 14 year old girl was admitted to hospital in September 1945. The entrance complaint was limp and pain in the right hip aggravated by wet weather of 7 months duration. Examination revealed fairly good range of motion in the right hip except for absent internal rotation. Marked atrophy of the upper femoral metaphysis was seen on the anteroposterior roentgenogram and the lateral view revealed a mild posterior displacement of the femoral head (Fig. 7, a and b). The right upper femoral epiphysis was drilled and pinned in December 1945 without any previous hip manipulation. Four months after the operation the range of motion became very restricted, and the roentgenograms showed marked narrowing of the joint space. The femoral head appeared normal. Sedimentation rate, white blood count, hemoglobin, and other laboratory examinations were completely normal. The narrowing of the joint space and the limitation of motion progressed and in December 1946 the right hip was fixed in a position of 40 degrees flexion. The roentgenograms at that time showed a very irregular subchondral line with spreading ossification into the deep layers of the joint cartilage of the femoral head (Fig. 7, c). The threaded Steinmann pins were then removed and the hip was gently manipulated under anesthesia. Only 30 degrees of flexion extension motion were possible. The patient was last examined in May 1947 when only a few degrees of flexion extension motion could be detected in the right hip joint (Fig. 7, d). The left hip has always been completely normal.

CASE 3. A 15 year old boy was first admitted to hospital in August, 1942 in this clinic. The entrance complaint was pain and limp in the right hip of 3 weeks duration. The patient had only 35 degrees of active flexion in the right hip. Passive motion was almost normal. Roentgenograms showed a preslipping of the right femoral epiphysis. The patient was advised to use crutches and limit weight bearing on

the affected limb. Seven months later an acute slipping occurred in the right hip. The patient was not seen until 5 months after the accident, when the right hip was manipulated under anesthesia. The position of the displaced head was not changed during the manipulation. Necrosis of the femoral head did not occur. One year later there was marked limitation of motion in the hip joint with irregularity of the subchondral line of the femoral head and acetabulum and marked thinning of the joint space. An intertrochanteric osteotomy was performed to correct flexion and external rotation contracture which had developed in the right hip joint. The patient was last seen 3 months later in September, 1944, when the examination revealed very limited motion in the right hip joint. The left hip was clinically normal but the roentgenograms taken on the last admission showed marked narrowing of the joint space in both hips.

We have been unable to determine the nature of the process responsible for the symptoms described in these 3 patients. In only one case was material for histological examination obtained when the process was quiescent. The lesions resembled the quiescent stage of a mixed type of arthritis.

SUMMARY

Seventy three patients with slipped upper femoral epiphysis seen at the University Hospital in Iowa City from 1932 to 1947 have been reviewed. Nineteen patients had bilateral slipped epiphyses.

This series of patients was divided into 5 groups as follows:

1. Preslipping stage—5 patients, 1 with bilateral preslipping. This potentially dangerous stage was treated best by drilling and pinning as soon as the diagnosis was established.

2. Acute slipping or fracture separation of upper femoral epiphysis—19 patients, 1 with bilateral acute slipping. Best results were obtained by early and gentle reduction of the fracture separation maintaining the reduction by 2 or 3 threaded Steinmann pins. A bone graft used to maintain fixation may be preferable. It is advised that when these patients are seen more than 2 weeks after the accident no attempts should be made to reduce the slipped epiphysis. An intertrochanteric osteotomy may give good results in these cases without damaging the blood supply to the femoral head.

3 Chronic slipping with minimal to moderate displacement—31 patients 4 with bilateral chronic slipping Rest from weight bearing or plaster cast immobilization gave good results the epiphysis closed on an average of 9 months Drilling and pinning of the upper femoral epiphysis offered assurance against further slipping or acute slipping the epiphysis closed on an average of 6 months and the patients had free use of the extremity 1 month after the operation

4 Chronic slipping with marked displacement—21 patients 5 with bilateral chronic slipping The prognosis in this type is poor under any form of treatment This should be directed first toward preventing further slipping and hastening fusion of the epiphysis Neck osteotomy will restore the alignment of the femoral head and neck but loss of blood supply to the femoral head is too frequently the price Better results may be obtained by drilling the upper femoral epiphysis followed by an intertrochanteric osteotomy performed un-

der vision through an anterior incision with rotation and displacement of the distal fragment medially

5 Residual deformities—4 patients 1 with old bilateral slipping

The clinical symptoms physical and roentgenographic findings and results of various types of treatment in these groups are recorded.

Three patients developed early and marked narrowing of the joint space and are presented in some detail A fascial arthroplasty was performed in one of these patients The specimens obtained at operation revealed lesions similar to the ones seen in the quiescent stage of a mixed type of arthritis No evidence of inflammation was noted

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Nevertheless during the past 35 years in which this operation has become so widely accepted there have been sporadic attempts to develop operative procedures that would sufficiently answer the need for wide excision and yet preserve anal continence. This has been particularly true where the lesion was situated in the lower sigmoid or rectosigmoid junction. Lockhart Mummery in 1908 and Balfour in 1910 reported their experiences with anastomosis over a rectal tube.

A new drive for eliminating the permanent colostomy was initiated in 1935 by Devine who presented a technique for colostomy of the transverse colon which would completely defunction the distal colon permitting later resection and anastomosis followed by closure of the colostomy. No doubt the principle of this procedure is sound but the operation was not widely accepted and with the new antibiotic agents of recent years it will probably become less popular.

In 1937 Horsley presented his technique for resecting the rectosigmoid which consisted of a preliminary cecostomy and an open anastomosis deep in the pelvis. Since 1939 reports of cases of re-establishment of bowel continuity and preservation of the anal sphincter have come from Arnold, Bacon, Babcock, Dixon, Dunphy, Fallis, Murray and Wangersteen. The individual techniques, the indications for and selections of, cases have varied but their writings exhibit a common desire to escape the permanent colostomy.

Previous to 1941 I had occasionally restored intestinal continuity with lesions of the lower sigmoid but never if the lesion involved the rectosigmoid. During the year 1941 and early months of 1942 I anastomosed the terminal ileum to the mid or lower rectum in 7 cases. This operation of ileorectostomy was done because with wide excision of the upper sigmoid at that time it was impossible to anastomose the colorectal ends low in the pelvis. Of these 7 patients 3 established fairly satisfactory bowel habits even though the terminal ileum emptied directly into the mid or lower rectum. In 4 of the cases with anastomosis to the lower rectum there was a troublesome diarrhea. This procedure has been discontinued except in cases of multiple polyposis with

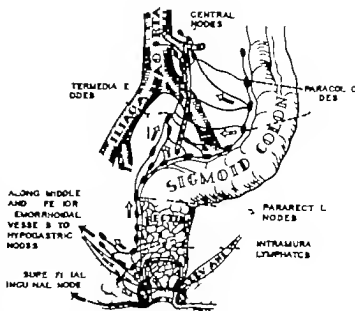


Fig. 1. In the anal canal, 3 modes of spread are considered. The anal skin is drained by lymphatics leading to the superficial inguinal nodes. Above the skin margin is an intermediate area which may drain laterally to under surface of the levator ani and then through this muscle to the hypogastric nodes or directly upward into intramural lymphatics. The upper anal canal and lower rectum may drain into the hypogastric nodes or progress upward along the pararectal nodes. Observations suggest that pararectal and paracolic nodes tend to drain into the intermediate nodes but if these become blocked, the spread is likely to be directly upward along the paracolic nodes.

rectal cancer. The more recent interpretation of lymphatic spread has resulted in a less radical excision of the sigmoid colon and rectum which permits end-to-end anastomosis deep in the pelvis.

Can we conform to the principle of radical cancer surgery in carcinoma of the rectum and rectosigmoid and still preserve the sphincter mechanism? This requires some modifications of Miles' interpretation of the mode of spread—namely upward laterally and downward. A challenge to Miles' teachings is supported by the study of lymphatic glands in surgically removed specimens and in autopsies by West, Huer, Gabriel, Dukes and Bussey, Gilchrist and David and Coller, Kay and McIntyre. These studies reveal that dissemination of cancer cells in a downward direction is unusual unless the lymphatics above the tumor are blocked by metastasis. Intramural spread of cancer cells below the lower margin of the tumor is a rarity and studies by the aforementioned investigators suggest that a clearance of at least 1 inch and preferably 2 inches is a

re establishment of bowel continuity is usually attempted. Three types of operative procedures have been selected to permit sphincter preservation. These are abdominal dissection, resection and anastomosis; abdominal dissection with perineal resection and anastomosis; and perineal dissection with perineal resection and anastomosis.

THE ABDOMINAL DISSECTION WITH RESECTION AND ANASTOMOSIS

The abdominal dissection with resection and anastomosis is selected when the upward spread is limited as heretofore discussed and the lower margin of the lesion is at least 7.5 centimeters (3 inches) from the anal margin. The actual lower margin of the tumor frequently varies from the preoperative estimate by rectal examination. The sacculated structure of the rectum permits elongation of the rectum when pulled upon from above and as the operation progresses the lesion may actually be several centimeters higher than was anticipated. Again one should not always depend on this sacculatation resulting in an elevation of the lesion. If we are to play safe

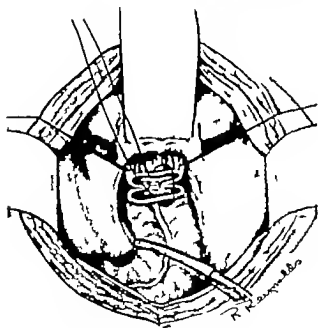


Fig. 4. The posterior sutures have been tied. One anterior catgut suture with knot on mucosal wall to initiate inversion has been inserted. Remaining sutures will be figure-of-8 or mattress silk sutures.

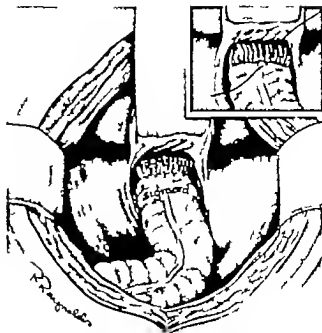


Fig. 5. A single layer of interrupted figure-of-8 or mattress silk sutures complete the anastomosis.

with our present knowledge of cancer extension in this region, the rectum should be resected at least 2.5 centimeters (1 inch) below the lower margin of the tumor, and we feel that 3.5 centimeters (1½ inches) to 5 centimeters (2 inches) is preferable, even though in low lying lesions this may impede anastomosis from within the abdomen. An open type of anastomosis has been used because in lesions below the lower sigmoid the difficulties with closed anastomosis seem greater than the advantages. A technique has been developed which has served well. Just before the operation is started, a large rubber catheter which has been attached to the suction machine is inserted into the rectum to make sure that it is empty. After the usual study of the vascular pattern the superior hemorrhoidal vessel or its branches are properly ligated to assure adequate vascularization of a sufficient upper segment of sigmoid to permit anastomosis. However, one must remove an adequate zone of probable lymphatic spread or extension. It is usually necessary to divide the middle hemorrhoidal vessels, yet there appears to be adequate vascularization of the lower rectal stump as noted by bleeding from the rectal wall. A right angle clamp is applied (Fig. 2) at

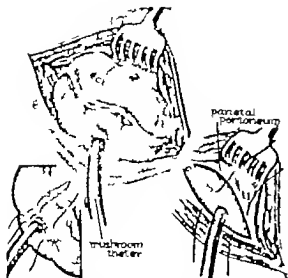


Fig. 6 A supplemental cecostomy is performed by puncturing a mushroom catheter into the cecum. The rectal wall is inverted and the cecum fixed to the parietal peritoneum.

least 2.5 centimeters (1 inch) below the tumor margin and preferably 4 to 5 centimeters (1.5 to 2 inches). Two short nosed right angle clamps grasp either side of the rectal wall just below the right angle clamp. The rectum below the crushing clamp can then be severed with an angled knife without too much difficulty. At a level high enough above the tumor to be above the level of direct lymphatic spread and through viable sigmoid a soft bladed clamp is applied or a rubber drain or tube is clamped or tied around the bowel. This is done several inches or more above the level of transection in order to permit open anastomosis low in the pelvis. After the bowel segment with the tumor is removed the remaining clamps on the lower segment are replaced by two long catgut sutures. These are permitted to hang over the pelvis to steady the rectal stump. The two ends of the bowel are prepared for bringing into apposition by inserting a long catgut suture on either side of the midline (Fig. 3) in the posterior aspect. The ends of the bowel are guided along these sutures to the juxtaposition and as these sutures are tied with knots on the mucosal side, the rectal and sigmoidal walls are inverted. A similar catgut suture is placed anteriorly (Fig. 4). The anastomosis is then secured by accurately placing a single layer of interrupted

figure-of-8 silk sutures (Fig. 5). A rubber Penrose drain is placed in the hollow of the sacrum and the peritoneal margin of the pelvic floor is approximated above the drain and around the sigmoid at a level above the line of anastomosis.

Before the abdomen is closed a modified Gibson cecostomy (Fig. 6) using a mushroom catheter is accomplished through a small muscle splitting incision on the right side. It is our observation that a patient is more comfortable with a cecostomy tube for decompression than with nasogastric or nasointestinal suction and probably a cecostomy is a much more efficient safety factor in colon anastomosis. In my experience, this type of cecostomy has always closed spontaneously if obstruction is not present.

The patient is then turned over on his left side, a small incision is made along the coccyx through the fascia propria into the space in the hollow of the sacrum to permit delivery of the previously placed rubber drain.

Placing the sutures deep in the pelvis is quite difficult and awkward and not infrequently there must be some failure in the suture line. However we must not be too disturbed about this because certain experiences in rectal injuries during World War II substantiate the fact that proper healing will oc-

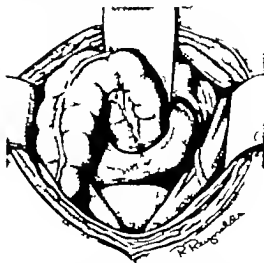


Fig. 7 The abdominal dissection has been completed and the pelvic peritoneum is loosely closed around the sigmoid. Abdominal incision is closed and the sigmoid and rectum are pulled out of posterior incision.

cur It was found that in rectal injuries by single or multiple shell fragments life would be saved and rectal healing would usually take place if the fecal contents were diverted by a colostomy and proper posterior drainage of the perirectal space in the hollow of the sacrum was established. Although cecostomy does not completely sidetrack the bowel contents suction applied to the tube and proper posterior drainage have given excellent results. The amount of posterior drainage has varied. At times it is minimal and again there may be considerable drainage with a fecal odor or even frank feces. Generally the tracts have closed within a week or two although in 2 cases closure took several months.

ABDOMINAL DISSECTION WITH PERINEAL RESECTION AND ANASTOMOSIS

A second type of operative procedure may be indicated when the lower margin of the tumor is at or just below the 7.5 centimeter (3 inch) level. Also it may be suspected before operation and confirmed at the operating table that the anastomosis could not be completed from within the abdomen because of a small pelvis. In this event the abdominal dissection is car-

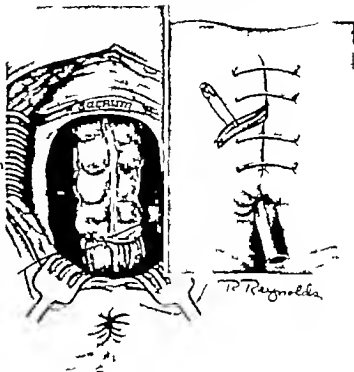


Fig 9. Completion of posterior anastomosis. An outer layer of interrupted silk mattress or figure-of 8 sutures is inserted.

ried out in the usual manner but the rectum is not transected. It is determined that sufficient viable sigmoid remains to be brought down for anastomosis and the level of transection is labelled by a small black suture. The peritoneum of the pelvic floor is closed but not too snugly around the sigmoid. A Gibson type cecostomy is established, the abdomen is closed and the patient is placed in the prone position with hips elevated or placed in the left lateral Sims position. An incision is made over the sacrum and coccyx; the coccyx is excised and the sigmoid and tumor are delivered (Fig. 7). Sufficient further dissection is done to permit adequate transection below the lower margin of the tumor. A soft bladed clamp is applied above the level of the identifying black suture. A crushing clamp is applied below this and the sigmoid is severed. Another crushing clamp is applied an inch or more below the tumor margin. Several Allis clamps steady the lower segment as the rectum is severed below the crushing clamp. The lower stump is swabbed out with sulfanilamide solution. The end-to-end anastomosis is accomplished by inserting interrupted catgut sutures in such a manner as to leave the knots on the inner or

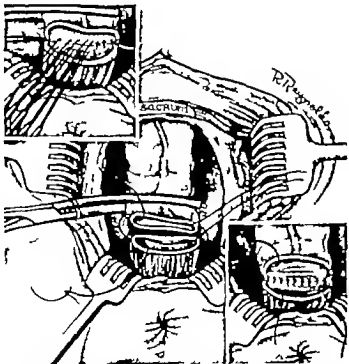


Fig 8. Posterior anastomosis with inner row of interrupted catgut sutures. To facilitate procedure all posterior sutures are inserted and then tied.



Fig. 9. Posterior dissection (full) of rectum and anastomosis. Anastomosis completed (Figures 8 and 9).

mucosal wall (Fig. 8). Interrupted mattress sutures of silk are inserted around the entire circumference to complete the anastomosis (Fig. 9). By means of an accessory rubber glove the line of anastomosis is examined from within the rectum. The wound is well irrigated with warm saline solution and sulfanilamide powder is frosted throughout. A Penrose drain is placed in the hollow of the sacrum. The remaining levator muscle tissue and fascia are closed around the rectum with interrupted chromic catgut sutures. These are supported with several heavy silk sutures which also approximate skin and subcutaneous structures. If a supplementary cecostomy was not established a rubber rectal tube may be inserted up through the line of anastomosis and then fixed to the anal skin. Which is the better method is difficult to say at this time.

PERINEAL DISSECTION WITH PERINEAL RESECTION AND ANASTOMOSIS

The third type of anastomosis for carcinoma of the rectum will be indicated in relatively few cases. One hesitates to say that it is fundamentally sound because one is probably too conservative in removal of the tissue above the lesion which is in the zone of established

spread. However it may be the operation of choice in some poor risk patient when the entire lesion is palpable per rectum. Also it may be done in selected cases in which the tumor is small.

The lower margin of the tumor is at least an inch above the upper margin of the muscular anal canal and the upper margin can be palpated by the examining finger. The tumor should not be fixed to surrounding structures and should be confined to the mucosa. Murray has recently reported 15 cases in which operation consisted of posterior resection and anastomosis. The tumor area is approached by a midline incision over the sacrum and coccyx extending to within one half inch of the anal margin. The coccyx is removed and possibly the fifth sacral body. The tumor is freed as for a posterior excision after the method of Lockhart Mummery. The peritoneum is opened close to the rectal wall and sufficient sigmoid is delivered to permit excision of the tumor segment and anastomosis of the rectum to the rectal or anal stump (Fig. 10). Anastomosis is accomplished as described in the operation for abdominal dissection with posterior excision and anastomosis (Figs. 8, 9). The wound is liberally flushed with saline and frosted with sulfanilamide. In these cases cecostomy has been omitted but a $\frac{1}{2}$ or $\frac{3}{4}$ inch tube has been inserted into the anorectal canal to above the line of anastomosis. The perirectal space is drained and tissues closed as previously described. The tube is stitched to the perianal skin. With our limited experience in this type of operation we are undecided as to the necessity for a supplementary cecostomy. Further experience may prove that it is desirable.

It is our opinion that a nonabsorbable sulfonamide preferably sulfathaladine is indicated for 4 to 5 days preoperatively in the preparation of a patient for anastomosis. With open types of anastomosis some soiling takes place and these drugs may be a safety factor against invasive infection. On several occasions rather gross soiling has occurred without event. Penicillin has been given postoperatively in 25,000 to 50,000 unit doses every 4 hours beginning immediately and continued for 5 to 10 days. In several cases where a marked break in technique occurred surprisingly clean posterior wounds have resulted.

ANALYSIS OF CASES

During a recent 6 month period, I saw 18 patients with carcinoma of the rectum or rectosigmoid. Surgery was advised in all but 3 instances. One of these 3 patients had a rather large tumor fixed to the sacrum and surrounding structures, with urinary incontinence secondary to a previous perineal prostatectomy, and electrocoagulation was selected as the method of treatment. Two other cases were labelled inoperable because of extensive local disease and evidence of distant metastasis. This is an 84 per cent operability rate. Of the 15 patients explored 13 (72 2 per cent of the 18 cases) were resected. Of the 13 resectable lesions only 2 were subjected to abdominoperineal excision with permanent abdominal colostomy. In the other 11 patients (84 6 per cent of the resectable lesions), colostomy was avoided by anastomosis of the sigmoid, rectal or anal segments. Of the 11 cases 8 were done by abdominal resection and anastomosis 2 by abdominal dissection with posterior resection and anastomosis and 1 by posterior dissection resection and anastomosis. There was one hospital death in a case of abdominal resection and anastomosis in a large heavy set individual when probably the result would have been different if a combined abdominoperineal excision had been done. This is a mortality rate of 6 6 per cent for the patients subjected to operation and a mortality rate of 7 6 per cent for patients subjected to resection. This mortality rate in a rather small series of cases in which where sphincter preservation has been accomplished in 84 6 per cent of the cases compares quite favorably to the mortality rate in cases in which the avoiding of colostomy is not attempted. However I believe a higher potential mortality exists as the operation is more difficult, more time consuming and the incidence of infection is undoubtedly higher where an awkward anastomosis is attempted. Before the advent of the antibiotic agents now available and the more energetic use of blood plasma and whole blood transfusions, resection and anastomosis of the rectal segments carried a much higher morbidity and mortality rate, and this restricted the enthusiasm for sphincter preservation. In obese and poorer risk patients abdominoperineal ex-

cision or posterior excision without anastomosis would seem to carry less hazard

CONCLUSIONS

At this time, very few conclusions can be drawn as to the probable end results over the 5 and 10 year periods in these operations for restoring intestinal continuity after resection of the rectum and rectosigmoid. In general, the sphincter function has been adequate and in most cases remarkably satisfactory. Theoretically as based on anatomical and pathological dissection an effort should be made to prove or disprove the expediency of this less destructive operative procedure but only after another 5 years or more with reports from numerous authors can the true evaluation be made. In the interval, however, some patients will have had a happier existence for a longer or shorter period because of a retained sphincter mechanism. If the end results in 5 year cures or ultimate cures do not vary more than 5 to 10 per cent from the results of abdominoperineal excision with permanent colostomy, the operation should be one of choice or at least patients should be given an opportunity to make the decision. Our present evaluation of the more conservative operation as regards morbidity and mortality is predicated on results obtained when we were unable to exercise the finer details of judgment, technique, preoperative and postoperative care, and control of infection.

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TISSUE PROTEIN DEPLETION

A Factor in Wound Disruption

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WOUND disruption has been reported in 15 per cent of abdominal operations (9). This occurrence is associated with a mortality of 35 per cent, and a train of complications such as intestinal obstruction, peritonitis, and incisional hernia. The more common etiological factors are technical errors, poor suture material, compromise of the nerve and blood supply of the wound, infection, obesity straining by coughing, vomiting or distention, debilitation by systemic disease, vitamin C deficiency (10), and hypoproteinemia (16, 17, 33). This study concerns the relationship between protein depletion and wound disruption.

Clark in 1919 showed that a diet high in protein shortens the lag period in the repair of experimental wounds. Such a diet accelerates the return of the wound to maximal tensile strength (11). Utilizing a serial tensile strength method (19), Localio and Hinton (20) have shown that gain in wound strength is markedly delayed in hypoproteinemic rats.

Thompson and associates were the first to implicate protein deficiency as a major factor in postoperative wound disruption. Koster and Shapiro (17) shortly thereafter demonstrated that in cases of human wound dehiscence the mean serum protein concentrations were lowered. Serum protein levels of less than 6.0 grams per cent were noted in 42 per cent of the 40 cases of wound disruptions reported by Koster and Kasman (16).

In reviewing several cases of evisceration which had the benefit of meticulous operative technique, nonabsorbable suture material (cot-ly), massive doses of vitamins preoperatively, and in which no wound infection occurred, we noted normal plasma protein levels in all of the patients. However, protein deficiency was suspected clinically. This led us to question whether significant depletion of the tissue proteins might occur in the face of essentially normal serum protein levels, and whether the concentration of tissue proteins might in such cases be more directly related to wound healing than the level of the circulating serum proteins. Consequently, the attempt has been made to compare tissue protein concentrations in cases of wound dehiscence with those of normal patients.

In the course of these studies we have been impressed with the need for clarification of the present terminology. For instance the term "hypoproteinemia" is far too often used as a synonym for protein deficiency in general. Elman (8) states that the term protein deficiency rather than hypoproteinemia has much to recommend it as a more accurate and useful designation. In order to provide a simpler terminology it is proposed that the term "hypoproteinism" be adopted in referring to the depletion of protein from the tissues of the body in general, whether or not serum protein concentrations, as determined by the usual clinical methods, are significantly reduced. "Hypoproteinemia" should be used only to describe a subnormal serum protein concentration.

MATERIAL

The patients were chosen from the Surgical Services of the New York Post Graduate Hospital and the Fourth Division of Bellevue Hospital and the Doctors Hospital, New York.

A control group of 17 individuals was made up of patients who were undergoing laparotomy for benign conditions and who were considered on the basis of history and physical examination to be in a good state of nutrition.

The second group of 21 consisted of patients suffering from a debilitating disease, and who were therefore suspected of hypoproteinism.

Because of their preoperative clinical condition they were also considered to be potential candidates for wound dehiscence. Fourteen had gastrointestinal carcinoma or peptic ulcer.

A third series of 17 patients had experienced postoperative wound disruption.

METHODS

In all cases blood samples were drawn for serum protein determinations either immediately before or after operation. The method used for total protein concentration was modified from Koch and McMeekin. The albumin fraction was isolated according to Howe. Tissue protein concentrations were determined by a technique similar in principle to that used by Elman and Helfetz (7) namely:

Tissue specimens consist of about 2 to 3 square centimeters of fascia, peritoneum and muscle. The specimens are taken during operation from the rectus muscle and sheaths superior to the semilunar fold of Douglas. They are carefully dissected free of fat and other adherent tissue, wrapped in gauze slightly dampened with isotonic saline, and rushed to the laboratory. They are weighed immediately to the nearest milligram on an analytical balance. Each specimen is then placed in a 50 cubic centimeter volumetric flask with about 0.5 cubic centimeter of concentrated (100 gm per 100 c.c.) sodium hydroxide and 8 to 10 cubic centimeters of isotonic saline. The flask is placed in a boiling water bath until the tissue is completely digested (30 to 60 minutes). Upon cooling, saline is added to the 50 cubic centimeter mark. An aliquot consisting of 3.0 cubic centimeters is placed in a Nessler protein tube and the total nitrogen is determined by the same method as for serum protein. The resultant tissue nitrogen concentration is multiplied by 6.25 to give the protein concentration in percentage of wet tissue.

RESULTS

Table II lists the results to the group of 21 patients who were considered clinically to be in a state of hypoproteinism. All but 6 have normal serum protein levels. The tissue protein concentrations vary considerably. In comparing the fascial protein concentrations of this group with those of the normal patients of Table I it is seen that no normal patient had a fascial protein concentration of 24.0 per cent or below. If 24.0 per cent is chosen as the lower limit of normal, then 11 of the 21 debilitated patients in Table II demonstrate a diminished fascial protein concentration despite the fact that 5 of these 11 patients had preoperative amino acid therapy. Six had normal serum proteins at the time of operation.

The 17 cases of evisceration (Table III) have significantly lower mean tissue protein concentrations than the patients of the normal control group. This is illustrated in Table IV. The mean fascial protein concentration of the patients who had wound disruptions is also significantly lower than that of the debilitated patients who did not suffer disruption as shown in Table V. Serum protein levels were low in only 4 of the 17 cases of evisceration, even though the determinations were made on blood drawn at the time of evisceration. Unfortunately, serum albumin levels are not available for most of these patients.

DISCUSSION

It is generally agreed that a subnormal serum protein concentration denotes protein deficiency. The converse, however, need not be true. Our results indicate that significant tissue protein depletion may exist in the face of normal serum protein levels, which by present clinical standards are normal. In this study, using the method of Koch and McMeekin, we have considered 6.0 grams per cent to be the lower limit of normal for total serum protein concentration in agreement with Kagan and Trevorrow.

TABLE I.—TISSUE PROTEIN CONCENTRATIONS IN NORMAL PATIENTS

Case No.	Age	Diagnosis	Operation	T.S.P. gm. %	Alb. gm. %	Tissue protein concentrations per cent of wet tissue			Preop. nitrogen i.v.	Suture material	Remarks
						Fascia	Peritoneum	Muscle			
		N. disease	Exploratory laparotomy	7.5	—	2.1	24.3	17.0	20 gm d. X7	Cotton	
4		Cholelithiasis	Cholecystectomy	7.0	—	5.6	23.8	9.5	—	Catgut	
3	43	Cholelithiasis	Cholecystectomy	6	—	8.8	25.6	20.6	—	Catgut	
4	5	Cholelithiasis	Cholecystectomy	8	—	25.0	6.4	.3	—	Cotton	
5	43	Ut. leiom.	Hysterectomy	7.0	—	25.0	6.0	3	—	Cotton	
6	60	No disease	Exploratory laparotomy	8.2	—	27.3	11	5.7	20 gm d. X7	Cotton	
7		Ovarian cyst	Ovarian cystectomy	7.0	—	20.2	4.7	10.6	—	Cotton	
8	4	Cholelithiasis	Cholecystectomy	7	—	4.3	9.0	—	—	Cotton	
9		Isthmocolic abscess	Exploratory laparotomy	6.9	—	20.6	16.3	23.5	—	Cotton	
10		Sigmoid diverticulitis, mild	Exploratory laparotomy	7	1.6	0	24.6*	2.2	—	Cotton	
33		Retroposition of uterus	Uterine suspension	6.5	3.7	27.6	9*	7.0	—	Catgut	
40		Healed appendiceal abscess	Interval appendectomy	7.7	5	24.4	9	7.9	—	Cotton	
3	4	Pelvic inflammatory abscess	Panhysterectomy	6	3.7	3	20.6	23.4	—	Catgut	
4	4	Appendiceal abscess	Isthmocolic drainage	6.9	2.7	27	7.4*	9.4	—	Cotton	
5	4	Cholelithiasis	Cholecystectomy	6.0	4.6	27.4	—	16.0	—	Cotton	
16	47	Ovarian cyst	Ovarian cystectomy	8.0	4.9	20.2	.3	20.7	—	Cotton	
7	49	Acute appendicitis	Appendectomy	7	4.7	20.7	7.0	7.3	—	Cotton	

Mean tissue protein concentration

Standard deviation

20 24 20 0-23

± 3.67 ± 2.00 ± 2.26

*Peritoneum taken below semistarvation fold of Douglas and therefore omitted from consideration.

There are many reasons why the serum protein level may be misleading as an index of the state of protein nutrition. Reduction in the total circulating serum albumin is often accompanied by considerable decline in plasma volume, thus tending to maintain a normal serum protein concentration (18, 22, 24, 25, 28). Meyer and Kozoll attempt to detect this hemoconcentration by serial determinations of the hematocrit. Unfortunately however some of the most crucial surgical patients suffer from various degrees of anemia simultaneously with hypoproteinemia, thus tending to nullify the hemoconcentration effect.

Determination of the serum protein level without evaluating the albumin fraction frequently will fail to disclose a hypoalbuminemia, which is masked by the presence of hyperglobulinemia secondary to chronic infec-

tion (13, 25) and other stimuli. Thus, in some instances, a state of hypoproteinemia may be detected by albumin determinations but not by the total serum protein concentration. Unfortunately the accuracy of the albumin determination, as routinely performed in many laboratories, leaves much to be desired.

If it is true that the total serum protein concentration is not a reliable index of hypoproteinemia, the question then arises as to whether accurate determination of the albumin fraction will solve this problem. Elman and his co-workers (6, 8, 31) in this regard have emphasized the work of Weech who noted a prompt hypoalbuminemia in dogs on a protein-free carrot diet. That this is not necessarily applicable to human patients can be seen from the fact that in young men placed on a semistarvation diet with a protein con-

TABLE II.—TISSUE PROTEIN CONCENTRATIONS IN DEBILITATED PATIENTS

Case No.	Age	Diagnosis	Operation	T S P gm %	Alb gm %	Tissue protein concentration per cent of wet tissue			Preop. sample	Surgery material	Remarks
						Fascia	Peri- liver	Muscle			
1	6	Cirrhosis of liver jaundice	Exploratory laparotomy	6	—	9	—	1.6	100 gm d X 7	Cotton	
		Repos. intestines	Resect. of ileum and right colon	8	—	1	1.6	1	100 gm d X 0	Cotton	
2	6	Metastatic ca. of liver	Exploratory laparotomy	6	—	10.1	1.7	1.6	—	Cotton	
3	33	Ca. of colon	Resection of colon	6.3	—	10.1	1.1	1.1	100 gm d X 0	Cotton	
4	31	Gastric ulcer	Gastrostomy subtotal	6	—	—	1	1	—	Catgut	
5	6	Carcinoma of peritoneum	Exploratory laparotomy	—	—	1	6	1	100 gm d X 7	Cotton	Peritoneal edema P O 113
	79	Ac. cholecystitis	Cholecystectomy	1	—	6	10	6	—	Cotton	
8	37	Duodenal ulcer	Subtotal gastrectomy	—	—	14	10	1.6	—	Cotton	
9	60	Ca. of sigmoid	Resection of sigmoid	6.1	—	10.1	6	—	100 gm d X 1	Cotton	
	70	Oes. str. str.	Exploratory laparotomy	—	—	6	1.1	1	100 gm d X 1	Cotton	
6		Intest. ob. du. postoperative	Lysis of adhesions	—	—	9	10.1	1	—	Cotton	
	15	Ca. du. peritoneum	Exploratory laparotomy	6	—	—	—	6	—	Cotton	
3	63	Ca. of sigmoid	Resection of sigmoid	1.1	—	10.1	7	1	—	Cotton	
14	44	Cholelithiasis with jaundice	Cholecystectomy	6	1	1	10	—	—	Cotton	
1	40	Duodenal ulcer	Subtotal gastrectomy	6	6	10.1	7.4	10.1 gm d X 1	Cotton		
16		Duodenal ulcer	Subtotal gastrectomy	6	4.1	10	10.1	10.1 gm d X 1	Cotton		
17	33	Ca. of sigmoid	Resection of sigmoid	6.1	1	10	6.6	1	—	Catgut	
18	60	Duodenal ulcer	Subtotal gastrectomy	7	1	6	10.1	10.1 gm d X 1	Cotton		
19	7	Ac. cholecystitis	Cholecystectomy	1.1	—	10	1.1	1	—	Cotton	
20	34	Ca. stomach with metast.	Resection of stomach and jejunum	6.1	—	14.1	1	10.1 gm d X 1	Cotton		
21	60	Ca. colon	Resection of colon	6.1	—	1	1	10	—	Cotton	

Mean tissue protein concentration
Standard deviation4.32 36 1.07
1.99 $\pm 1.7 \pm 1.1$

tent of only 49 grams a day for a 6 month period, the plasma protein fell only slightly and the A/g ratio remained within normal limits (14). This was despite the fact that these 34 men lost an average of 24.5 per cent of their body weight and all developed significant edema. Other recent studies (5) have confirmed the finding of normal serum albumin and total protein concentrations in the presence of famine edema. No clear explanation of this phenomenon was offered. Thus, even the serum albumin level is not a consistent index of hypoproteinemia.

Ravdin predicted that if the means to determine it were available, the first effect of

protein undernutrition is a reduction in the amount of protein stored in the tissues of the body since every attempt is made to maintain the serum protein concentration at a near normal level. However it has never previously been demonstrated by direct measurement that depletion of tissue protein actually does occur in humans in the presence of normal serum protein concentration. Our results demonstrate that depletion of the fascial protein may be revealed by the method described at a time when the serum protein concentration is within normal limits. The muscle nitrogen concentration is not as sensitive an indicator of early hypoproteinemia. One factor

TABLE III.—TISSUE PROTEIN CONCENTRATIONS IN CASES OF WOUND DISRUPTION

Case N	Age	Diagnosis	Operation	T.S.P. gm. %	Alb. gm. %	Tissue protein concentration per cent of wet tissue			Preop. amigva i.v.	Suture material	Remarks
						Fascia	Peri- toneum	Mus- cle			
1	56	Carcinoma of stomach	Gastrectomy	4.0	—	13.	13.4	14.5	Preop. 50X7 Postop. 50X7	Cotton	Evisceration p. 7
2	57	Uterine leiomyoma ovaries cyst	Hysterectomy oophorectomy	7.3	—	0	14.	5.7	—	Catgut	Evisceration p. 7 severe cough p. 6-7
3	6	Perforated peptic ulcer	Suture of perforation	7.0	—	20.2	9.9	14.8	—	Catgut	Evisceration p. 8
4	36	Perforated peptic ulcer	Suture of perforation	6	—	7.7	26.	6.8	—	Catgut	Evisceration p. 7 bronchopneumonia p. 8
5	56	Uterine leiomyoma	Hysterectomy	5.5	—	—	14.5	—	—	Catgut	Evisceration p. 6 TSP 7.4 gm. % on date of operation
6	67	Carcinoma of rectum	Abdominoperineal resection	3.0	—	9.	17.4	8.9	—	Cotton	Evisceration p. 8
7	38	Perforated peptic ulcer	Closure of perforation	5	—	7.5	9.6	18.9	—	Catgut	Evisceration p. 8
8	65	Ca. of sigmoid	Anterior resection	6	—	9.8	1	9	Preop. 100X6 Postop. 100X5	Cotton	Evisceration p. 10 wound infection p. 6
9	46	Intestinal obstr.	Lysis of adhesions	9.6	—	9	24.5	0	—	Cotton	Evisceration p. 8
10	44	Ca. of transverse	Colostomy	6.3	—	20.4	7.7	6.7	—	Cotton	Evisceration p. 9 died p. 9
11	56	Duodenal ulcer	Gastrectomy	7.5	—	20.5	—	0	Preop. 100X5 Postop. 100X5	Cotton	Evisceration p. 7 sev. cough p. 5-7
12	59	Ca. of transverse	Exploratory lap.	6	—	7.9 7.3	24.5 20.3	13.9 5.6	—	Cotton	Evisceration p. 8 and evis. p.
13	5	Ca. of sigmoid	Resection of sigmoid	7.4	—	16.0	25	3.0	100 gm. d. X 6	Cotton	Evisceration p. 12
14	37	Duodenal ulcer	Subtotal gastrectomy	7	9	20.3	6.3	8.7	Preop. X post. op. 100 gm. d. X 7	Cotton	Evisceration p. 7 severe cough
15	85	Bleed. duod. ulcer	Subtotal gastrectomy	6.4	2.5	7.5	5.3	7.8	4 l. blood	Cotton	Died p. 7 of uremia with disrupt. of fascia and peritoneum
16	67	Perf. of stomach, traumatic	Suture of perforation	6.7	1.7	7	—	7.6	—	Cotton	Evisceration p. 7
17	45	Gastric ulcer	Subtotal gastrectomy	7	3.9	4.4	8.4	5.4	Preop. 100X5 Postop. 100X4	Cotton	Evisceration p. 0.

Mean tissue protein concentration
Standard deviation

8.75 9.77 6.8
± 3.3 ± 3.5 ± 3.3

may be the rapidity with which muscle loses moisture. It has been noted that a 250 milligram sample of wet muscle may lose as much as 20 milligrams per minute during weighing thus is introduced a serious technical error.

In view of the acknowledged importance of the fascial layer in wound healing it is of interest that the lowest tissue protein values were encountered in the fascia of patients with wound disruptions, indicating that severe

hypoproteinemia frequently occurs in these cases despite apparently normal serum protein levels. It is therefore considered that the degree of protein depletion of the fascia is more directly related to failure of wound healing than is the degree of serum protein depletion as measured by total protein concentrations.

Outstanding among the recent advances in the field of protein metabolism is the concept of 'dynamic equilibrium' which governs the

TABLE IV — COMPARISON OF MEAN TISSUE PROTEIN CONCENTRATIONS IN CASES OF WOUND DISRUPTION AND IN NORMAL PATIENTS

	Normal patients per cent	Wound disruptions per cent	Differences per cent	Statistical significance ^a
Mean protein concentration of fascia	40.00	18.73	21	t = 4.36 P less than .01 Therefore significant
Standard deviation	3.67	3.3		
Mean protein concentration of peritoneum	24.90	9.77	15	t = 3.78 P less than .01 Therefore significant
Standard deviation	3.90	2.1		
Mean protein concentration of muscle	70.25	76.8	6.5	t = .42 P = .68 Therefore probably insignificant
Standard deviation	26	3.53		

^aThe statistical significance of the difference between the two groups was tested by the t-test as described by Fisher, R. A. in *Statistical Methods for Research Workers*, 7th ed. Edinburgh, Oliver and Boyd, 1954. The standard deviation of the difference between the respective means was calculated by the formula:

$$S.D. \text{ Diff.} = \sqrt{\frac{\sigma_1^2}{N} + \frac{\sigma_2^2}{N}}$$

where σ_1 and σ_2 are the standard deviations of the normal and the disruption groups respectively and N and N are the number of cases in each group respectively.

interchange of proteins between the blood and tissues (31). Following rapid plasma protein depletion by plasmaphoresis, a normal dog may re-form as much as 40 to 60 per cent of its total circulating plasma proteins even during fast (23). Whipple and his co-workers (23) showed that the source of the regenerated serum proteins were reserve stores of protein metabolites existing in various tissues. The nature and location of the tissues reserves have posed a difficult problem. It has been suggested by Addis (1, 2) that the liver has a large fraction of labile protein which may be utilized by the organism during fast. The composition of this reserve protein is apparently identical with the total protein of the liver cells (21). That the dynamic equilibrium between serum and tissue proteins operates in the reverse direction may easily be illustrated by maintaining animals in positive nitrogen balance for indefinite periods of time on protein free diets supplemented only with intravenous injections of plasma (37). In a healthy organism, of course, it is expected that the tissue cells are capable of participating in the

TABLE V — COMPARISON OF TISSUE PROTEIN CONCENTRATIONS IN CASES OF WOUND DISRUPTION AND IN DEBILITATED PATIENTS

	Debil- itated patients per cent	Wound Disruptions per cent	Differences per cent	Statistical significance
Mean protein concentration of fascia	4.38	18.73	14.35	t = 4.46 P less than .01 Therefore significant
Standard deviation	3.90	3.3		
Mean protein concentration of peritoneum	8.6	9.77	1.09	t = 1.26 P = .25 Therefore probably insignificant
Standard deviation	7.7	3.3		
Mean protein concentration of muscle	7.5	6.83	.67	
Standard deviation	5	2.53		Not significant

dynamic equilibrium of protein metabolism and of extracting from the total pool of body protein the metabolites necessary for their specific functions. It may be however that this equilibrium is disturbed in the diseased state. This suggests another possible explanation for the disparity between the protein concentration of the tissues and the serum, as noted in Table III.

One may account for the disparity between the determined protein concentrations of the tissues and the serum in several ways. The serum protein concentration may not reflect a reduction in total circulating proteins because of a contracted plasma volume. The total serum protein level may be normal in the face of hypoalbuminemia. Normal total serum protein and albumin levels have been shown to occur in severe hypoproteinemia and even in nutritional edema (14, 30). The body may attempt to maintain homeostasis of the serum protein concentration at the expense of tissue proteins (29). In diseased states there may be breakdown or delay of the dynamic equilibrium between serum and tissue proteins.

By way of practical application our findings serve to emphasize the study of the patient as a whole rather than of his serum protein concentration. The extensive literature on "hypoproteinemia" in surgery has focused considerable attention upon the results of the serum protein determination alone. Unfortunately too often a normal serum protein level has been interpreted to be an adequate

index of the preoperative patient's protein nutrition. Needless to say a normal serum protein concentration often affords a sense of security that is entirely false and the surgeon may underestimate badly the quantity of protein necessary properly to prepare his patient for major surgery. Calculation of the probable protein needs of the preoperative and post-operative patient should be based upon the nature and duration of the lesion, the dietary history, loss of weight and clinical appearance and not solely upon the result of a serum protein determination. Cases of gastrointestinal carcinoma (3) and peptic ulcer (27) for example should receive intensive preoperative protein therapy. This is especially true because in cases involving gastric or intestinal anastomoses, failure of wound healing at the site of anastomosis is tantamount to catastrophe. Varco has recently provided a practical guide to the methods of protein therapy.

Since our data are at present incomplete with regard to the relationship between tissue proteins and the serum albumin fraction studies in this direction are now being pursued and will be reported later. Preliminary findings indicate that under certain conditions, hypoproteinism may occur even with normal or borderline albumin concentrations.

SUMMARY AND CONCLUSIONS

1. The level of tissue proteins was determined in fascia, peritoneum and muscle in normal humans.

2. Estimation of the protein concentration of the fascia is offered as a means of ascertaining the state of protein nutrition.

3. Depletion of the protein of the fascia seems to be an important factor in the etiology of wound disruption.

4. The total serum protein may be maintained within normal limits even in the face of significant depletion of the tissue protein. Hence in humans, the serum protein concentration does not constitute an adequate index of the state of protein nutrition.

5. The term hypoproteinism is proposed to describe the state of depletion of tissue protein whether or not this is accompanied by simultaneous depletion of serum protein.

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EDITORIALS

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JANUARY 1948

VAGOTOMY

ALTHOUGH numerous debatable issues remain regarding the exact place that vagotomy should assume in the treatment of peptic ulcer since Dragstedt and his associates focused attention on this procedure in 1943 certain aspects of the subject have become defined with a fair degree of clarity. It therefore seems appropriate that some comment be made at this time regarding what has been learned and the deficiencies in our knowledge which still exist. Many of the physiologic effects of bilateral section of the vagus nerves in man have been repeatedly demonstrated and verified. It is of more than 10

and gastric hypomotility results. Other less significant effects also have been noted. Vagotomy does not eliminate sensory stimuli from the stomach or duodenum.

The influence of vagotomy on the accessory organs of digestion has been incompletely investigated from a physiologic point of view. To date no serious deleterious effect on the function of these structures has become apparent. Certain symptoms, such as diarrhea and abdominal cramps which occasionally occur after vagotomy have not been satisfactorily explained. Likewise our knowledge is incomplete concerning the physiologic effects of vagotomy on the small intestine and large bowel. A most important question which has not been answered definitely as yet is how long the effects of vagotomy persist. Certain experimental evidence (Vanzant) as well as some clinical evidence presented by Moore suggests that the effects of vagotomy may be temporary. Results of other clinical studies do not substantiate this point of view. Clarification of this important point will require further time. Various methods of dealing with the cut ends of the vagus nerves have been devised and tried in order to obviate possible regeneration and restoration of vagal continuity. Physiologic studies made several years or more ago determined that vagotomy to determine

interested in the subject. Thus Grimson Colp and many others agree that thoracic vagotomy alone should not be employed as a routine operation for the treatment of duodenal ulcer. This is largely because of failure of the stomach to empty properly in a significant percentage of cases in which the thoracic approach has been used. This failure may occur even despite lack of evidence preoperatively to suggest pyloric obstruction. In addition this procedure affords no opportunity for verification of the lesion at the time of operation which in itself is not an inconsequential consideration.

In contrast most all agree that vagotomy alone constitutes a most welcome contribution to the treatment of jejunal ulcer which occurs after gastric resection. In fact it is thought by many that this lesion constitutes the most definite indication for vagotomy today. Opinion is less well formulated on the use of vagotomy alone in the management of jejunal ulcer which follows gastroenterostomy for under these circumstances the second phase of gastric secretion remains active.

At present most discussion revolves around abdominal vagotomy associated with gastroenterostomy as the operation of choice for duodenal ulcer. According to Dragstedt this is a most satisfactory operation, however Walters and others have reported somewhat less brilliant results. A final decision on this subject will require the lapse of more time. At the time when end results are reported, evidence also should be presented regarding the percentage of cases in which the postoperative finding suggested either complete or incomplete section of all vagal fibers. I have found it more difficult to feel confident that all vagal fibers were sectioned when an abdominal rather than thoracic approach is used. Not all surgeons have this opinion. The abdominal approach affords the obvious advantages of

permitting direct inspection of the lesion and the abdomen in general in addition to an opportunity to perform any associated surgical procedure that is indicated. Theoretically the operation which should afford the greatest chance to cure duodenal ulcer and prevent subsequent jejunal ulcer is vagotomy associated with high resection of the stomach. It seems possible that in a small group of selected cases this operation may have a certain field of usefulness.

Most surgeons agree that in the treatment of gastric ulcer vagotomy should seldom be used because of the excellent results which follow properly performed gastric resection and the possibility of failure to remove an actual carcinoma. Vagotomy might be considered in the small group of gastric ulcer which by all evidence appear to be benign and which are situated in such proximity to the esophagus that extirpation of the lesion would require total gastrectomy. The number of such cases is extremely small for in the large majority of high lying gastric ulcers subtotal gastric resection with removal of the ulcer or local excision and gastroenterostomy can be performed. In exceptional cases of this type subtotal gastric resection without removal of the ulcer may be considered if the ulcer has all the appearance of benignity.

JAMES T. JENNINGS

THE NURSE ANESTHETIST

THE purpose of this editorial is to consider the case of the nurse anesthetist and to examine some of the factors that will influence the man without bias who must consider the matter.

The controversy. Whether or not the nurse anesthetist is a valuable adjunct to the care of the patient has been a matter of discussion for a few many years. Many will be surprised if surgery are in any disagreement

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ALTHOUGH numerous debatable issues remain regarding the exact place that vagotomy should assume in the treatment of peptic ulcer since Dragstedt and his associates focused attention on this procedure in 1943 certain aspects of the subject have become defined with a fair degree of clarity. It therefore seems appropriate that some comment be made at this time regarding what has been learned and the deficiencies in our knowledge which still exist. Many of the physiologic effects of bilateral section of the vagus nerves in man have been repeatedly demonstrated and verified. It is of more than passing interest that these observations coincide closely with those made previously in the experimental laboratory. Thus it is known that after vagotomy the neurogenic stimulation of gastric secretion is removed, the amount of nocturnal gastric secretion is reduced, emotion fails to alter the gastric mucosa, hypoglycemia does not stimulate the secretion of gastric acid,

and gastric hypomotility results. Other significant effects also have been noted. Vagotomy does not eliminate sensory stimuli from the stomach or duodenum.

The influence of vagotomy on the accessory organs of digestion has been incompletely investigated from a physiologic point of view. To date no serious deleterious effect on the function of these structures has become apparent. Certain symptoms such as diarrhea and abdominal cramps which occasionally occur after vagotomy have not been satisfactorily explained. Likewise our knowledge is incomplete concerning the physiologic effects of vagotomy on the small intestine and large bowel. A most important question which has not been answered definitely as yet is how long the effects of vagotomy persist. Certain experimental evidence (Vanzant) as well as some clinical evidence presented by Moore suggests that the effects of vagotomy may be temporary. Results of other clinical studies do not substantiate this point of view. Clarification of this important point will require further time. Various methods of dealing with the cut ends of the vagus nerves have been devised and tried in order to obviate possible regeneration and restoration of vagal continuity. Physiologic studies made several years or more after vagotomy to determine the status of vagal function should state clearly what method was employed to secure the ends of the vagus nerves.

Granted that vagotomy still is in the phase of clinical trial and that at present complete unanimity of opinion does not exist regarding the indications for this procedure, a certain amount of agreement in respect to certain points seems to prevail among those most in-

terested in the subject. Thus Grimson Colp and many others agree that thoracic vagotomy alone should not be employed as a routine operation for the treatment of duodenal ulcer. This is largely because of failure of the stomach to empty properly in a significant percentage of cases in which the thoracic approach has been used. This failure may occur even despite lack of evidence preoperatively to suggest pyloric obstruction. In addition this procedure affords no opportunity for verification of the lesion at the time of operation which in itself is not an inconsequential consideration.

In contrast, most all agree that vagotomy alone constitutes a most welcome contribution to the treatment of jejunal ulcer which occurs after gastric resection. In fact it is thought by many that this lesion constitutes the most definite indication for vagotomy today. Opinion is less well formulated on the use of vagotomy alone in the management of jejunal ulcer which follows gastroenterostomy, for under these circumstances the second phase of gastric secretion remains active.

At present most discussion revolves around abdominal vagotomy associated with gastroenterostomy as the operation of choice for duodenal ulcer. According to Dragstedt this is a most satisfactory operation; however, Walters and others have reported somewhat less brilliant results. A final decision on this subject will require the lapse of more time. At the time when end results are reported evidence also should be presented regarding the percentage of cases in which the postoperative findings suggested either complete or incomplete section of all vagal fibers. I have found it more difficult to feel confident that all vagal fibers were sectioned when an abdominal rather than thoracic approach is used. Not all surgeons share this opinion. The abdominal approach affords the obvious advantages of

permitting direct inspection of the lesion and the abdomen in general in addition to an opportunity to perform any associated surgical procedure that is indicated. Theoretically the operation which should afford the greatest chance to cure duodenal ulcer and prevent subsequent jejunal ulcer is vagotomy associated with high resection of the stomach. It seems possible that in a small group of selected cases this operation may have a certain field of usefulness.

Most surgeons agree that in the treatment of gastric ulcer vagotomy should seldom be used because of the excellent results which follow properly performed gastric resection and the possibility of failure to remove an actual carcinoma. Vagotomy might be considered in the small group of gastric ulcers which by all evidence appear to be benign and which are situated in such proximity to the esophagus that extirpation of the lesion would require total gastrectomy. The number of such cases is extremely small for in the large majority of high lying gastric ulcers subtotal gastric resection with removal of the ulcer or local excision and gastroenterostomy can be performed. In exceptional cases of this type subtotal gastric resection without removal of the ulcer may be considered if the ulcer has all the appearance of benignity.

JAMES T. PRIESTLEY

THE NURSE ANESTHETIST

THE purpose of this editorial is to consider the case of the nurse anesthetist and to examine some of the factors that will influence the man without bias who must consider the matter.

The controversy. Whether or not the nurse anesthetist is a valuable adjunct to the care of the patient has been a matter for discussion for a good many years. Many well known professors of surgery are in sharp disagreement

with the majority of physician anesthetists on this question.

The controversy has been pointed up by the recent action of the American Society of Anesthesiologists. This organization has circularized hospitals with a copy of a resolution adopted by its Board of Directors June 11, 1947. As far as the present discussion goes, the most important part of this resolution is the disapproval expressed of the training of persons other than doctors of medicine in the science and art of anesthesia in short nurses.

Quoting further from the notice sent to hospitals: This resolution has been reproduced and commented upon in the *Journal of the American Medical Association* and many State and County medical journals. In none of these has it been criticized adversely. Nevertheless, the concept contained in the resolution has, as everybody knows, been criticized strongly both in and out of print. For example, as recently as January 11, 1947, Dr. Evarts Graham¹ said: "There are some prominent anesthesiologists who would eliminate completely the nurse anesthetist. They have even supported legislation in some states which would make it illegal for a surgeon to engage the services of a nurse anesthetist. The best solution to the problem then is to encourage the training of the nurse anesthetist until there are enough physician anesthesiologists to fill the demand." We may take it that there has been widespread criticism of the policy advocated by the resolution. The policy is under discussion.

Some weak points of hospitals in utilizing nurse anesthetists. There have been a good many instances of abuse of the earning power of nurse anesthetists by hospitals. The exploitation of one department of a hospital to support the institution must be condemned.

¹Graham, E.A. J.Am.M.Ass. 947:123, 97, 99.

It is wrong in principle. There is nothing in this which says that the anesthesia department should not contribute its fair share to payment of the hospital's overhead: bookkeeping, heat, light, janitor service, etc. If the hospital buildings have been given to the institution, no rental should be charged. The well-run department of anesthesia should also retain, after all of its own expenses are paid, a reasonable percentage of its earnings for further development of the department. If the department makes money beyond these charges, its fees should be lowered for the patient's sake.

The training of nurses by nurses without real medical supervision is another fair target for the anesthesia society to shoot at.

The above are problems of administration on the professional side. The fact that the clinical limitations of the nurse anesthetist are sometimes not adequately perceived.

The nurse anesthetist unquestionably has her limitations. In the writer's opinion, her peace-time activities should in most cases be limited to the administration of ether, anesthesia and nitrous oxide-oxygen. It has been said that if she is allowed to give ether she might as well administer pentothal sodium, cyclopropane, spinal anesthesia, etc. This statement is not sound for the simple reason that ether has the greatest factor of safety of any of the commonly used major agents. When the respiration fails from overdosage of ether, the intake stops spontaneously before circulatory damage has occurred. This does not appear to be true with other agents. The hazards of the nurse administering agents other than ether are sufficiently great so that she should be limited except in unusual circumstances to this agent and nitrous oxide. She still can be extremely useful.

Some vulnerable points in the argument offered by anesthesia groups. War was a great accelerator of development of the specialty

of anesthesia. Many surgeons in military service got better anesthesia than they had previously ever had. With this and other stimuli aiding the specialty, the tendency is to pull it in the desirable direction faster than it can go. The great limiting factor here is the present shortage of trained physician anesthetists. Of all the specialists in medicine, the anesthetist seems to be scarcest. He has the greatest scarcity value. It sometimes seems as though every one of the 7000 hospitals in the United States is trying to get a physician head for its anesthesia department. This is a fine tribute to the physician anesthetist and the place he has made for himself. It is by no means to be construed as a total rejection of the nurse anesthetist.

At present, well known anesthesia training centers have waiting lists of reassured size. This is not the case over the country as a whole. Many large as well as small hospitals are already feeling the shortage of physicians for training in anesthesia.

Great numbers of physicians recently discharged from the military services have been eager for training in anesthesia, but this pressure is now much less than it was. In another couple of years men released from the A S T P and V 12 programs will no longer be available. At the same time the expansion of government facilities, as well as the civilian demand over the country is increasing. For these and other reasons it seems probable that the shortage of good men for training in anesthesia will be increasingly acute for at least several years.

Any unnecessary pressure that adds to the critical nature of this situation will win the ill will of many physicians, especially surgeons who ought to be solidly behind the anesthetist. The resolution referred to can work to the harm of the specialty and in addition by giving rise to strong opposition defeat its own ends.

With the rapid development of physician anesthesia and with the great shortage of trained personnel, it is curious that the resolution referred to should be offered at this time. It of course immediately raises the question of who at present will assume the load now carried by the nurse anesthetist if the resolution is widely accepted. The local doctor on the case? In this period of critical shortage of trained personnel, to outlaw the nurse anesthetist would inevitably mean that in great numbers of cases the surgeon would be forced to use the local doctor on the case as his anesthetist. The inadequacies of this system do not need comment. The situation is hardly solved by the attitude, "We'll use 'em but we won't train 'em."

While large medical centers can often carry out their anesthesia responsibilities largely with a very low salaried resident staff and can keep the cost actually lower than it would be if nurses were used, this raises several problems beyond the scope of the present discussion. Even though this may be the case in the large medical centers, in the outlying hospitals where the bulk of surgery is done, abolition of the nurse anesthetist requires the employment of a physician anesthetist or the use of inadequately trained staff members. Aside from the fact that the physician anesthetist is in most cases at present unobtainable by the outlying hospital, it must be recognized that if he could be obtained, the cost of medical care will thus be increased, such increase to be embarked upon only with greatest caution.

The old line large hospitals are fairly generally running large deficits. A recent editorial in the *New York Times* (September 30) calls attention to the fact that hospital deficits in the New York area are about two and one half times in 1946 what they were in 1945. It is unlikely that the average smaller hospital in the country is better off. With the costs of

It is not to be expected that medical men will take these as surprising developments, for they will be pressed upon them.

The future of the nurse with the mental and physical training emphasized undoubtedly in the future will work a great revolution, turning nurse already certified into a nurse into an anesthetist.

Legal principles. The censorship of medical practices by society action (in so far as they tend to inflexible regimentation) may have a bad long range effect upon the society when applied to widespread general practices in the care of the patient.

The use of a certifying board for coercive action by threats to remove certification in order to alter widely accepted general practice may be questioned.

There is much talk of legalistic means to force and inevitably freeze the shape of medical practice. The hazards of this have been demonstrated. Recourse to law by a medical society in order to correct what it believes to be unsound professional practices will freeze

the undesirable along with the desirable. Since the law freezes inadequately tested procedures, it will be difficult to make later needed adjustments. Surely every thoughtful physician must look with deepest reluctance on moves by the medical profession to take to the law to shape its practice. Physicians need to guide their own affairs.

The future. The nurse anesthetist is needed now; what her future position will be the writer does not know.

Let us not try the impossible. We cannot at present fill the available positions for physician anesthetists; therefore of what use are impatient attempts to hasten an evolutionary process that is already proceeding faster than we can take advantage of it?

Unquestionably a well trained physician anesthetist should head the department of anesthesia with as many physician associates as the needs of his institution require. It seems inescapable that with current shortages in this field continued training of the nurse anesthetist is at present indicated.

HENRY K. BRECHER.

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THE BOOK SHELF

THE CANCER OF DESTINY

ESTHER H VINCENT Evanston, Illinois

NAPOLÉON was dropped from the womb of time on sun baked Corsica, a bare rock mass of an island its thorns and water torrents, its dark ribbons of pines thrusting themselves ambitiously up out of the Mediterranean blue. Spoil of many a war, Corsica had scowled under Ligurian Carthaginian Roman Vandal Papal, Moorish and Genoese masters before finding it self a bit of French real estate. Its fishing villages and mountain hamlets still stand like gray heaps of stone, silently indifferent to the burning suns and scorching winds of adversity. Its fishermen and goat herders its fruit and chest nut growers, are a short statured grave folk filled with dreams of grandeur based on an innate sense of equality with the great of the earth. Theirs, too is a curious heightened sensibility to the thoughts of others, an uncanny susceptibility to the shadows of future events. Theirs is a deep love of solitude, from which they derive a feeling of security of courage and fidelity. Like all primitive people they are as vain as children and they are clan

nish to the point of absurdity favoring relatives regardless of personal worth and efficiency.

The Bonaparte family was of noble Tuscan ancestry but had dwelt in Corsica since the 16th

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century. Probably little Italian influence was left by the time young Napoleon appeared although the family name was spelled Buonaparte for many a year. Father Charles Bonaparte had married a young girl of the island, Letizia Ramolino by whom he had 13 children 8 of whom lived. Tall

and vigorously beautiful Napoleon's mother was said by him to have had the mind of a man. She shared the stormy life of the Corsican rebels under Paoli and many a tale is told of her sagacity and fearlessness. Once while crossing a turbulent river her horse lost its footing and was being carried downstream. Letizia ignoring the shouted advice to jump successfully guided the frightened animal to safety. She was then carrying Napoleon in her womb. Married at 15 Letizia lived through the dramatic rise and fall of her famous child even staying with him at Elba, and finally ending her days peacefully at Rome at the age of 86.

It was from his mother that Napoleon liked to think he had inherited those qualities that made him great. But it was from

his father that he feared he had inherited the physical constitution that would destroy him. Lawyer Charles Bonaparte fought with Paoli for the liberation of Corsica. Upon the defeat of the leader he retreated with his family to the mountains only to come down again to take up the life of a parasitical



NAPOLÉON BONAPARTE
1769-1821

[illegible]

All this time Napoleon lived with the fear of cancer. He did not want to talk about it and he never mentioned his father's illness if he could avoid it, but every now and then he would disclose a queer interest in anatomy, particularly in the anatomy of the stomach. However every time he tried to learn something about it, he got sick at it. Physically squeamish, he simply could not stand the sight of the parts of a dead body. When he was Emperor he took a few private lessons from his court physician, Corvisart, but the only result was a pale, nervous, depressed Napoleon whose wife, Marie Louise, wondered why he could not eat his dinner.

Whenever conversation turned upon digestion Napoleon always vehemently asserted that he had an excellent stomach. In reality he frequently had gastric pain, and even in early youth was subject to nausea and vomiting. Sometimes he would say:

"When disease appears in the stomach a physician expends in vain, for it is the restorative center itself which is affected. The stomach is the most important part of the body."

When his last physician, the inefficient Antomarchi, suggested that the exiled emperor's stomach might be diseased, Napoleon told him to stop his nonsense, that the Napoleonic stomach was perfectly sound! Yet, a month before his death with the true nature of his illness still unknown, he suddenly began to ask another of his attendants, Dr Arnott about the anatomy and physiology of the stomach. And in dying he repeated in delirium, "The pylorus. My father. The pylorus." And finally, consciously "I have known it for a long time."

This fixed idea that he would die from cancer of the stomach saved him from fear of death in any other form. Wounded in battle, he took no heed for he knew he would not die from bullets. His belief in his charmed life in combat was not fearlessness or bravery nor faith in his miraculous in-

vulnerability but certainly that death could touch him in one way only. Upon realizing the imminence of defeat at Waterloo, he deliberately put himself in the way of bullet streams, hoping to seal his fate but to no avail.

Along with his furtive interest in gastric anatomy went an almost despairing concern in the hereditability of disease. Four of his brothers and sisters, Lucien, Elisa, Pauline, and Carolina, all suffered from stomach afflictions (eventually all 4 died of cancer or of suspected cancer). Almost privately he would ask his physicians for assurance as to the impossibility of disease inheritance. He firmly believed in it, but wanted terribly not to!

According to Dr. Paul Gosset, "The Bonapartes were a dynasty as much arthritic as imperial. Such 'slowed-down nutrition' people are frequently victims of tense agitation, spenders of reserve, with a predisposition to serious disease. Generally impatient, they gulp their food, accelerate living in general and thus promote nutritional strikes."

The schoolboy Napoleon was short and thin. Lacking good muscular co-ordination, he could not throw stones with efficiency nor ride horses without falling off of them. Too awkward to weave his hair into the elaborate male coiffure of the day he resorted to professional hairdressers, and got the habit of carrying his three-cornered hat under his arm in order not to muss his hair. His 'nervous stomach' reflected his every emotion, and vomiting followed mental upset. Never could he digest milk, nor even foods prepared with milk. His great eyes stared out of his sickly face and his voice was harshly hollow. But his living habits were simple even Spartan, and he knew how to make use of such energy as he had, just as he knew how to make use of his fellow students.

A thin bedraggled, girl-like soldier of the Revolution he earned the title of 'Little Corporal' through his magical ability to spread the contagion of courage among the men with whom he ate his coarse black bread and with whom he slept on the straw-strewn ground under the cannon. Threatened with amputation of his bayoneted leg, he ignored surgeon Hernandez, and, without rest, returned to the fray that won Toluca for his army.

As a young lieutenant at Auxonne, he presented himself as a thin yellow creature, bedridden for many weeks with what was probably the malarial fever still endemic to that region. He bombarded Blenvelot, the regimental surgeon, with questions as to the nature of his illness, and 6 months later his health was still wobbly from the infection.

At Antibes in Château-Sallé he had a serious digestive disturbance which was treated by a Dr

Desgenettes who prescribed so long a list of ineffectual remedies that he nearly undermined Napoleon's faith in the medical profession and at the same time, nearly killed him with oratory. At this time, Napoleon looked like a vagabond, with his clumsy uncertain gait, shabby clothes, and emaciated body. Stendhal states that the Napoleon of this period was the thinnest and most peculiar looking individual he had ever seen.

After the execution of Robespierre, the ensuing crisis in the Revolutionary Convention led to the appointment of Napoleon as commander in chief of the army. The feverish activities consequent upon this first step to power did not improve his health. Josephine was dismayed at his sickly looks. After their marriage, he continued to have colds and racking coughs and chest pains. Corvisart diagnosed the trouble as pulmonary congestion although he refrained from alarming Napoleon by telling him so. It is highly probable that Napoleon was suffering from an active pulmonary tuberculosis spontaneous recovery occurring later when at the close of his consulship, life grew easier for him. Corvisart's treatment of the acute attack was successful however and Napoleon was so pleased with the distinguished doctor that he made him his personal physician showering him with honors.

Napoleon's talent for judging personal worth served him well in his choice of medical men. The great Larrey was his chief military surgeon and Corvisart was not only his first physician but also his very good friend. In 1803 Corvisart had a national reputation as clinician and teacher. Among his many brilliant pupils was Laennec, father of the stethoscope. Corvisart revived Auenbrugger's art of percussion and though he did not have auscultation he was a good diagnostician. At the time of his first meeting with Napoleon, Josephine asked the physician what he thought her husband would die of. Corvisart made a snap diagnosis of heart disease. Future clinical examinations and the autopsy showed nothing abnormal with the imperial heart. It had an even though slow beat, and never gave him any anxiety. But Corvisart's guess interested him led to a discussion of aneurisms and heart disease in general, and resulted in Corvisart's writing a book on the subject and dedicating it to Napoleon. Thus there came into being one of the first books on clinical cardiology Corvisart's *Essai sur les maladies et les lésions organiques du cœur et des gros vaisseaux* (1806).

Napoleon was quick to spy out a charlatan but had the highest regard for an honest physician. Corvisart attended both Josephine and Marie

Louise in their many imaginary ills and supported the latter's somewhat psychopathic pregnancy by dosing her with bread pills to her immense satisfaction. Corvisart stood by Napoleon even after the debacle of 1814, and it was only his own ill health (apoplexy) that kept him away from St. Helena.

Science, particularly medical science, fascinated Napoleon. Although hostile to mere speculation he enthused over practical research. He was so pleased with Jenner's vaccine discovery that he intimated French experiments on smallpox and authorized a decree ordering national vaccination. One of the first French children to be vaccinated was his own little son.

The Emperor was a difficult patient, however believing in natural self regulation and saying that he preferred to die from disease than from medicine. His physicians were forced to resort to hygienic measures alone. He was peculiarly sensitive to cold kept a fire in his room even in summer and daily boiled himself in hot baths, further stimulating his sluggish circulation by strenuous massage. Horseback riding also increased his bodily heat. He slept but a few hours at a time, could sleep and awaken at will on a campaign but would awaken quickly to a strange noise or odor at home. In later life pestered by dysuria, he changed beds frequently during the night. He often fasted but, when he did eat, he ate too much and too rapidly. As time went on he experienced severe gastric pain after meals, and sometimes nausea and vomiting.

Contemplating pictures of Napoleon in characteristic pose right hand stuck in his waistcoat and left hand thrust behind his back and aware of the prevalence of scabies in the France of the Revolution many people have thought that he was always scratching himself. Whether Napoleon had the itch or whether Napoleon did not have the itch is a moot point. Stories concerning it seem chiefly legendary however. He is said to have become infected with some kind of skin ailment at Toulon after he had replaced a slain comrade at his gun. This scabby affair known as *la gale* was very prevalent among the soldiers and it tormented Bonaparte for years. As popular verse, it broke out thus

Un jour Napoléon, me prenant par la main
Cette faveur est sans égale,
Dit De moi vous aurez quelque chose demain
Le lendemain, j'avais la gale

At this period scabies was regarded as a constitutional disease. To cure it was fatal for if driven from the skin it might turn up in the vital organs and contrariwise, an infected skin might drive

disease from the organs. Thus Napoleon in Egypt is said to have been exposed to the itch in order to cure his gastric pain. Whatever he had, whether scabies or dermatitis herpetiformis or what you will, its symptoms abated under the care of Corvisart, and appeared only at intervals thereafter as a chronic pruritus, turning into what Antommarchi termed "neurotic excoriations" at St Helena.

During the years of struggle for world power Napoleon grew increasingly nervous and irritable. His temper stable enough in important matters, disintegrated into paroxysms of anger over trivial frustrations. He raged at the courier who made an inept witticism, and at the valet who made a clumsy gesture. He developed a series of tic—spasmodic shrugs of the right shoulder, mouth twitchings from left to right, tremors of the left calf. At St. Helena, the mere presence of the abhorrent Governor Lowe would set Napoleon a leg to trembling. Along with tics and nervousness went a mania for destruction. He stabbed his chair arm with a penknife, ripped his clothing and smashed the china. He cried easily over trifles. An emotional tempest would occasionally bring on a nervous fit, and he would seem to lose consciousness and fall to the floor. Lombroso thought him a psychotic epileptic, with his insolent egocentricity and his lack of moral sense. Kovalevsky the Russian psychiatrist, also considered him epileptic, as did the Spaniard, Juarros. Nevertheless, many of the characteristic symptoms of epilepsy were absent, and his physicians never mentioned epilepsy in their records, nor even in their personal correspondence.

When about 40 years old, Napoleon began to gain weight and to acquire almost female contours. From sickly yellow his complexion changed to a marbly white. From dynamic seriousness, his expression changed to dull ennui. His speech became halting and hesitant, his public addresses cold and monotonous. Even his features seemed to change. He was often tired and sleepy, suggestive of a kind of narcolepsy. This slow decline of his powers affected the turn of history. Ségur attributes the failure of the Russian campaign to Napoleon's passivity. Two days before Borodino (September 1812) Dr. Meadivier reported that he had a continuous dry cough, difficult respiration, scant and painful urination, edematous legs, and feverish pulse. Although Napoleon soon improved in health, there is no doubt but that his ailments interfered with his efficiency. At Dresden he was seized with so violent a gastric pain that he made the faulty decision that cost him the battle. Pain and weariness were with him at Leipzig (October

1813) the battle which decided the fate of the Empire. Melancholy and apprehension followed him to Paris, where in April, 1814, he signed his abdication.

His flight from Elba coincided with a sudden outburst of activity, but his "march" to Paris was that of a tired, listless man riding in a carriage. His grave somnolency was at least partly responsible for his defeat at Waterloo (June, 1815).

The jagged, gloomy rock called St. Helena is 600 miles from the nearest land, and Longwood, the seat of Napoleon's exile, is at the summit of the island's most remote mountain, cold, damp, windy, shadeless, and waterless. The governor, Sir Hudson Lowe, a wretched bully of a man, was haunted by the idea that Napoleon was trying to escape. Aggravated by his prisoner's evident antipathy, he half killed him with petty annoyances. The mortality rate of the island was very high, most of its inhabitants dying from liver complaints. Lack of fresh vegetables added misery to Napoleon's other troubles. His hitherto perfect teeth began to ache and to decay.

The British physician Dr. Barry O'Meara, was banished by Governor Lowe in 1818, partly because the doctor showed sympathy with Napoleon, and partly because he diagnosed his illness as hepatitis, the disease for which the island was notorious. With O'Meara's departure, Napoleon was freed from an endless round of calomel and purgatives. He was without medical attendance for some months, refusing to see any medical man sent him by the governor. But in January 1819, he became so ill that a visiting ship's doctor, John Stokoe, attended him without governmental authority and was court martialed as a result.

Through the efforts of the Bonaparte family Dr. Francesco Antommarchi, a young Corsican, educated at Pisa and professor of anatomy at Florence, was sent to cure for Napoleon in September 1819. Antommarchi, influenced by Governor Lowe, regarded his patient's illness as imaginary, laughed at his agony and put tartar emetic in his lemonade. Whenever Napoleon needed him, Antommarchi usually had to be summoned from Jamestown, 3½ miles away. An experienced physician would have recognized the presence of serious gastric pathology, but Antommarchi merely aggravated Napoleon's sufferings by pouring drugs into him. At last Dr. Archibald Arnott, surgeon of the 20th Regiment, was called, and had the good sense to see that the disease lay not in the liver, but in the stomach. By this time (April, 1821) Napoleon was having gastric hemorrhages and his heart action was very weak. Antommarchi's remedy was to apply a vesicatory to the

epigastric region. On the 4th of May a day of tropical storm Napoleon was in complete collapse, and at 6 o'clock the following morning he was dead.

Twenty and a half hours after death, Dr Antommarchi held the autopsy in the presence of Dr Arnott and 6 other army surgeons. Strangely enough the body was fairly fat, the heart and omenta being adipose. The abdomen was distended, the peritoneum being covered with viscous fluid. On the anterior surface of the stomach at the lesser curvature near the pylorus there was found a complete perforation now closed with adhesions. The internal surface of the stomach was practically covered by a cancerous mass, as were all of the adjacent lymph nodes. The liver and spleen were engorged and there were many adhesions between the liver and stomach. The urinary bladder contained small calculi. The left kidney was slightly displaced and congenitally (?) enlarged. Antommarchi thought he saw signs of tuberculosis in the left lung but Arnott thought the lungs normal. The brain was not dissected.

Napoleon's body had many female characteristics—small hands and feet, smooth, practically hairless skin, wide hips, and narrow shoulders. The genitalia were small and atrophied possibly due to some pituitary lesion.

Cause of death was undeniably cancer of the stomach. The state of the bladder suggested the

cause of his frequency of micturition and dysuria. Fragments of an ileum purporting to be that of Napoleon, are preserved in the Museum of the Royal College of Surgeons. These specimens show evidence of Malta fever which Napoleon could conceivably have contracted while on Elba. It is known that he had feverish attacks on St. Helena. However, the origin of the fragments is very doubtful.

At first buried in a simple, unmarked grave on his island prison in 1840 the body of Napoleon was triumphantly returned to France. And once again, that strange Napoleonic power springing from the energy of a dynamic though never healthy man roused to ecstasy the Parisian crowd which with one mighty voice proclaimed, '*Vive l'Empereur!*'

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REVIEWS OF NEW BOOKS

WRITTEN from the combined experiences of a clinical neurologist, a neuropathologist, and a psychiatrist, *Neurosyphilis* by Merritt, Adams, and Solomon approaches the subject from the total standpoint. The emphasis on the progressive pathological picture, e.g. the relationship of the meningeal reactions seen early in the disease to the late picture of tabes dorsalis, general paresis, or diffuse meningovascular involvement is well placed. This relationship is unfortunately slighted in many books which describe categories as static lesions with the result that the importance of early preventive treatment of the more curable phase of the illness is missed.

The book is well documented, first with a rich clinical material available to the authors in two large American cities and second with a generous review of the literature. Many of the illustrations are related to old therapies, e.g. Swift Ellis now outmoded but the lessons are clear.

The general practitioner, not too conversant with neurological and psychiatric thinking may object to the detail of neuropathology neurophysiology psychopathology and psychiatric serology but such criticisms are easily answered. The neurosyphilist will enjoy the detailed descriptions of the meningeal lesions, the vascular lesions and the varying clinical picture. The relative incidence of these lesions is shown clearly, and differences between simulating lesions like multiple sclerosis and cerebral arteriosclerosis emphasized in the case histories. The combination of syphilis with other neurological disease, e.g. brain tumor is pointed out so that valuable weeks and months will not be lost in misdirected treatment.

The limitations of therapy in neurosyphilis may be appreciated in the clinical illustrations. Too often the medical student is taught that syphilis is treated by "specific" drugs and hence is curable. He projects this concept into neurosyphilis, forgetting that the scar of tabes or the organized thrombus in the middle cerebral artery leave irreversible defects in the neural mechanism. This book corrects such thinking but emphasizes the reversible lesions, the early meningeal involvements, the mild vascular syndromes and of course, the parenchymatous lesions of general paresis. Since many of the case illustrations are old, fever therapy does not receive the prominent place it now holds. Similarly in the light of the developments of the past 2 years, the chapter on penicillin is pitifully small and the information meager. Already a second edition is called for as the data, pre-

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The book has the not unusual sins of a first edition, errors in grammar but these are trivial, easily corrected in a second edition.

The book, however, is a real addition and is recommended for the library of every neurologist, psychiatrist, syphilologist, and the general practitioner who encounters sizable numbers of these patients in his practice.

BENJAMIN BOONIN

HOWEVER complete, *Penicillin in Syphilis* by Moore¹ is intended only as a supplement to an earlier and larger volume, *The Modern Treatment of Syphilis* by the same author now in the third printing of the second edition. A book on penicillin in syphilis had to be written and it is well that this was done by a thorough student and a mature writer. The errors of a first edition enthusiast, both scientific and rhetorical are thus avoided. Penicillin is a potent therapeutic aid a useful one a substance which has already established itself in the medical and public eye. It has its uses and its limitations, and as use becomes more conversant with this antibiotic, its dangers too. A tremendous literature on penicillin in syphilis had accumulated because the need was great for a safer, less time-consuming, and more economical drug than bismuth or arsenic.

To collate this literature to sift it down to what was definite carefully controlled, statistically significant, required a person who was thoroughly familiar with syphilis as a disease and with penicillin as a therapeutic agent. It was fortunate therefore, that Dr. Moore elected to write this book as a supplement to his textbook on *The Modern Treatment of Syphilis*. The author recognizes that many of the facts in the book are dated that tables of dosages are being tested and revised daily that more complete evaluations of penicillin G, N, K, etc. and of even the so-called impurities are already appearing. However someone must prepare a baseline and the reviewer appreciates the historical features, the experimental data, and the basic pharmacological facts which appear in the first 8 chapters. These are the pillars on which the use of a drug is built and it was essential to document them. To prepare this rich literature collected and critically reviewed in one volume is a real contribution. Some may object to wading through this mass of material, but not the research worker or the alert clinician be he specialist or not. Some of the chapters on therapy are long others are short. These are not sins of omission, but merely the author's principle of adhering to facts.

¹PENICILLIN IN SYPHILIS. By Joseph Earle Moore, M.D. Springfield, Ill. Charles C. Thomas, 1945.

INTRODUCTION. By H. Houston Merritt, A.B., M.A. Hon. M.D., R. Wood D. Adams, M.A. M.D. and Harry C. Solomon, B.S. M.D. New York, Oxford University Press, 1946.

Penicillin is a drug which is being tested continuously in certain designated qualified places, as well as by individual research men. The validity of data is related to available material. It will take a long time to collect a statistically significant series of Erb's syphilitic spinal spastic paraplegia. There are simply too few cases therefore such a chapter is brief as yet.

The style of the book is easy and friendly. Despite numerous tables, graphs and discussions of data, the pages can be read rapidly. There is an amazing freedom from gross grammatical errors for a first edition. This reviewer found only one slip page 259 where the author lists the pupillary changes, the fifth third and second cranial nerve involvements of tabes dorsalis as cerebral. The word *cerebrum* could well be left out of paragraph 4. The legibility of the book is enhanced by a large clear type appearing on nonreflecting pages. Details stand out clearly in bold-faced type.

Penicillin in Syphilis is recommended to everyone who is interested in the antibiotic as such or in the modern treatment of this ubiquitous disease.

BENJAMIN HOGHTON

THREE new chapters have been added in the second edition of *Human Gastric Function* by Stewart Wolf and Harold G. Wolff published 4 years ago. The work extends that of Dr. Beaumont on Alexis St. Martin and of Dr. Carlson on Mr. V., and is primarily a report on the gastric functions of Tom as they were affected by drugs by mechanical stimuli, and especially by emotion. Tom at 9 years developed an esophageal stricture after drinking extremely hot clam chowder and submitted to a gastrostomy. These studies were carried on when Tom was in his fifties, and the investigators used ingenious and skillful techniques in their work.

They observed that after liquids had been introduced into the stomach there was a temporary inhibition of gastric contractions. Fluids introduced directly into the duodenum resulted in more prompt inhibition of gastric contractions but the duration of effect was the same. Many believe that this effect of fluids accounts for the relief that ulcer patients obtain when milk and alkalies are administered. Wolf and Wolff found that introduction of acid inhibited contractions. Palmer however has shown that introduction of acid accentuates ulcer pain. Possibly the inhibitory action of fluids may be lost when ulcer or inflammation of the mucous membrane is present.

Mucin content they believe important, for occasionally when acid values have been very high mucin content has been low. This has occurred during periods of serious dilemma in Tom's life. They observed that alcohol effected an increase in vascular secretion and motor activity. Smoking caused

no significant change. As for a large group of chemical agents used many were able to influence motor activity vascularity and acid secretion though the effect varied in accordance with the subject's prevailing emotional state at the time or with his affective reaction to the experimental procedure itself.

Profound alterations in gastric functions as well as in other bodily patterns were found to accompany emotional disturbances. There was depression of function if the patient withdrew from an emotionally charged situation and acceleration of function if he assumed an aggressive attitude. This influence of the emotions emphasizes again the importance of the mental outlook of a patient with ulcer and the necessity of teaching him to change his reactions to the problems of living.

There is one study of a patient with peptic ulcer before and after vagotomy. The results are valuable because of the present interest in bilateral vagotomy. Apparently the vagi are not essential to the gastric hyperemia that follows the ingestion of a meal.

Everyone interested in physiology and gastroenterology is indebted to Tom and to the authors for this scientific study and well written book.

ARTHUR J. ATKINSON

IN trying to include all of the diseases of the locomotor system as well as rheumatic fever in one volume Dr. Fletcher has undertaken a Herculean task. In *Medical Disorders of the Locomotor System Including the Rheumatic Diseases* he has an excellent approach which is to classify everything on an etiologic basis and also to take into consideration the physiologic aspect as well as the changes in anatomy. He realizes that these pioneer efforts are attended with difficult problems which will have to be solved in the future. He has deliberately given much prominence to the rheumatic diseases since he recognizes that they are a social scourge and a national problem the world over. He has devoted long chapters to the anatomy and physiology of the locomotor system, but he recognizes the lack of complete and reliable information on the physiologic side. He has obtained help from 20 contributors on different subjects. This has the advantage of making the discussions of all of these subjects authoritative and based on experience with the disadvantage that the complete unity of the book has been interrupted.

One of the best things about the book is that it is up to date and at the same time the author passes judgment on new ideas of other authors. He has a critical opinion of the ideas that have recently been advanced by some authors. He bases his opinion on the anatomy and physiology and in general he is quite sound.

The book has a thorough discussion of rheumatoid arthritis and its relation to rheumatic fever. Osteoarthritis is discussed in general, and also for specific

HUMAN GASTRIC FUNCTION: AN EXPERIMENTAL STUDY OF A MAN AND HIS STOMACH. By Stewart Wolf, M.D., and Harold G. Wolff, M.D. 2d ed. London, New York, Toronto: Oxford University Press, 1947.

MEDICAL DISORDERS OF THE LOCOMOTOR SYSTEM INCLUDING THE RHEUMATIC DISEASES. By Ernest Fletcher, M.A., M.D. (Cantab.) M.R.C.P. Baltimore: The Williams & Wilkins Co., 1947.

REVIEWS OF NEW BOOKS

WRITTEN from the combined experiences of a clinical neurologist, a neuropathologist, and a psychiatrist *Neurosyphilis* by Merritt, Adams, and Solomon approaches the subject from the total standpoint. The emphasis on the progressive pathological picture e.g. the relationship of the meningeal reactions seen early in the disease to the late picture of tabes dorsalis, general paresis, or diffuse meningovascular involvement is well placed. This relationship is unfortunately slighted in many books which describe categories as static lesions with the result that the importance of early preventive treatment of the more curable phase of the illness is missed.

The book is well documented, first with a rich clinical material available to the authors in two large American cities and second with a generous review of the literature. Many of the illustrations are related to old therapies, e.g. Swift-Ellis now outmoded but the lessons are clear.

The general practitioner, not too conversant with neurological and psychiatric thinking may object to the detail of neuropathology, neurophysiology, psychopathology and psychiatric serology but such criticisms are easily answered. The neuropsychiatrist will enjoy the detailed descriptions of the meningeal lesions, the vascular lesions and the varying clinical picture. The relative incidence of these lesions is shown clearly, and differences between simulating lesions like multiple sclerosis and cerebral arteriosclerosis emphasized in the case histories. The combination of syphilis with other neurological disease e.g. brain tumor is pointed out so that valuable weeks and months will not be lost in misdirected treatment.

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BRUCE ROSEN

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¹PENICILLIN IN SYPHILIS. By Joseph Earle Moore, M.D. Springfield, Ill. Charles C. Thomas, 1946.

²NEUROSYPHILIS. B. H. Merritt, M.D., A.B. Merritt, M.D., Raymond D. Adams, M.A., M.D. and Harry C. Solomon, B.S., M.D. New York: Oxford University Press, 1946.

joints. Specific arthritides and gout are taken up. There is a chapter on sciatica and one on low back pain. The various causes of low back pain are given and the author has some insight into the disturbance in function that causes low back pain. The relationship of the decompensation in function to the anatomic changes is not clear. Poor posture is still thought of as a cause of the back disturbance rather than as a symptom of decompensation. There is no distinction between the cases in which the decompensation is caused by the anatomic changes and those cases in which the anatomic changes are the result of a decompensation. He has a chapter on the foot which brings out nothing new. In addition methods of treatment are discussed particularly with regard to physical therapy and various types of injections.

It is interesting to see a medical point of view brought to a subject that ordinarily comes under the field of orthopedic surgery, and the approach is of value not only to the medical man but also to the orthopedic surgeon and to all who have to do with disturbances in locomotor function, particularly of the rheumatoid type.

EMIL D. W. HAUER.

THE monograph *Les thyroidectomies* by R. Lebovici and Gilbert Dreyfus forms a part of a series entitled *L'avenir des opéris* and is evidently intended as a refresher course in the diagnosis, management, and complications of the hyperthyroid state. It suffers the handicap of having been written on the eve of the admission of the thyroidal compounds among the agents acceptable in the treatment of hyperthyroidism which circumstance substantially reduces its value. Aside from this limitation the treatise proves to be an orderly and detailed account of a classical medical entity and a careful analysis of the complications of the disease and of its treatment. The point of view is international enough and we have references to American, English, and German authors, although no formal bibliography is included. In the main, there is little disagreement between the French and American principles of diagnosis or of treatment. We all concede that careful evaluation is desirable and that "adequate thyroidectomy" is the therapeutic ideal. It is rather in the management of the residual and the recurrent hyperthyroidism that the French surgeons appear willing to enter upon a variety of therapeutic subterfuges, such as the use of protracted ligation and of irradiation, which would receive scant approval here. It is at this point in the treatise that analysis and definition cease to illuminate and tend to become a trifle specious.

EDITH B. FARRINGTON.

THE ambiguity of the title *Chirurgie fonctionnelle gynécologique* by R. Bourc is lavishly explained in the foreword and introduction as indicative of the author's desire to do surgery and conserve function. The proposition is fair enough, but the conservation

LES THYROIDECTOMIES. By R. Lebovici and Gilbert Dreyfus. Paris: G. Doin & Co., 1928.

of function would seem too obvious a therapeutic ideal to merit such enthusiastic development.

The book consists of an outline developed to meticulous redundancy under which is described in breezy fashion everything which the gynecological surgeon could possibly do good and bad, current and obsolete. It is a fabulous bag of tricks.

EDITH B. FARRINGTON.

THE monograph *Osteotomy of the Long Bones* by Henry Milch is based upon an interesting attempt to explain the failure and success of various osteotomies on a mathematical basis. New descriptive terms are introduced for well established procedures. Impressive laboratory procedures are the polariscopic examination of plastic models under stress, the geometric study of actual bones, and the manipulation of models. Some of the diagrams are simple and will aid the reader in understanding the basic mechanical principles involved in osteotomies. Some are abstract and will tend to confuse him. Mathematicians will be interested in formulas and equations involving higher mathematics; the philosophers in statements such as "While it is true that a straight line represents the shortest distance between two fixed points, it is equally true that for any fixed length a straight line represents the longest distance between two points. If a surgeon needs a geometric excuse for cutting off a painful protruding spine of bone he is given one."

The author's previous contributions are well presented, some of them in revised form. The book has convenient record of these. The practical analysis of the various types of osteotomies is of value. The varied applications of the high femoral osteotomy though not new may be so presented as to increase their utility.

The monograph shoots over the heads of most surgeons and will touch lightly only a few of those who have specialized in orthopedics.

WALTER P. BLOUNT.

THE 19th edition of May's *Manual of Diseases of the Eye* contains 387 illustrations including 37 plates with color figures. It is still a concise practical, and systematic manual intended for the student and general practitioner.

The death of the author, Charles H. May, in 1943 deprived American medicine of a great teacher. The present edition has been revised by Dr. Peters and he is to be congratulated for adhering to the original plan of the book, editing rather than rewriting it.

This edition has been brought up to date by including considerable new material, and several color plates and drawings have been added. The new topics included are penicillin therapy, modern therapy of color vision and its anomalies, thyrotoxic and

CHIRURGIE FONCTIONNELLE GYNÉCOLOGIQUE. By R. Bourc. Paris: Masson & Co. Librairie Docteur, 1927.

OSTEOTOMY OF THE LONG BONES. By Henry Milch, M.D. Springfield, Ill.: Charles C. Thomas, 1947.

MAY'S MANUAL OF DISEASES OF THE EYE. 19th ed. Edited by Charles A. Peters, M.D. Baltimore: Williams & Wilkins Co., 1947.

thyrotoxic exophthalmos, congenital cataract following maternal rubella and ocular brucellosis. Ocular requirements for admission to the Army, Navy Marine Corps Coast Guard and Aviation services of the United States are contained within the appendix.

May's *Manual* is one of the best textbooks on ophthalmology. It is hoped that future editions will continue to reflect the character and personality of the author.

IRVING PUNTERBERRY

THE fascinating and important field of the relationships of hormones to tumors is outlined in the symposium *Endocrinology of Neoplastic Diseases* edited by Gray H. Twombly and George T. Pack. The effect of hormones particularly the steroids in initiating and in augmenting or retarding neoplasia as well as the hormonal pictures produced by functioning tumors of the endocrine glands or by carcinomatous destruction of these glands are depicted in detail. Most of the topics discussed are still in the experimental stage and the authors have taken care to present the results of many investigators as completely as possible to evaluate this work briefly and then only to draw the most thoroughly substantiated conclusions. The defects in our knowledge are pointed out and the need of further research stressed. Such listings of results can make slow and difficult reading yet in this volume the reader is aided by the

ENDOCRINOLOGY OF NEOPLASTIC DISEASES. A Symposium by Eighteen Authors. Edited by G. H. Twombly M.D. and George T. Pack, M.D. New York: Oxford University Press, 1947

consistency and quality of the style of the different authors and by the thoughtful use of subheadings and frequent summaries. The data are timely. In some cases supplements having been added so that the latest work might be included.

Of particular interest to the clinician are the chapters on the endocrine effects of pituitary tumors by William German and on adrenal cortical tumors by Allan T. Kenyon in which the symptoms are tabulated and the mechanism for the production of each symptom postulated a rationale thus being given to the diagnosis of the unique syndromes these tumors may produce. Tumor endocrinology becomes important therapeutically in cancer of the prostate. This condition is described in detail and contrasted with the different problem presented by benign prostatic hypertrophy. The recent attempts at hormonal treatment of breast cancer are evaluated well by Ira T. Nathanson. The surgeon will be interested in the discussion of parathyroid enlargements by Oliver Cope and of pancreatic tumors by Allen O. Whipple. Attention is also given to tumors of the ovaries, the testes, the thyroid and of the pineal in this remarkably complete symposium.

These monographs will be of value to the practitioner to whom the diagnosis of hormone producing tumors is always a challenging problem to the surgeon in whose province the treatment of most of these conditions lies and to those interested in research in both endocrinology and cancer who will appreciate such a careful summary of investigations to date.

CHARLES HUGGINS

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

A PRIMER OF CARDIOLOGY. By George E. Burch, M.D. F.A.C.P. and Paul Reamer M.D. Philadelphia: Lea & Febiger 1947

UNIPOLAR LEAD ELECTROCARDIOGRAPHY INCLUDING STANDARD LEADS, UNIPOLAR EXTREMITY LEADS AND MULTIPLE UNIPOLAR PRECORDIAL LEADS. By Emanuel Goldberger, B.S. M.D. Philadelphia: Lea & Febiger 1947

400 YEARS OF A DOCTOR'S LIFE. Collected and Arranged by George Rosen M.D. and Beate Caspari-Rosen, M.D. New York: Henry Schuman 1947

PRINCIPLES OF OCCUPATIONAL THERAPY. Edited by Helen S. Willard, B.A. O.T.R., and Clara S. Spackman, B.S. M.S. In Ed. O.T.R. Philadelphia: London: Mouton J. B. Lippincott Co., 1947

HISTORY OF MEDICINE: A CORRELATIVE TEXT ARRANGED ACCORDING TO SUBJECTS. By Cedilla C. Mettler A.B.

Ed.B. A.M. Ph.D. Edited by Fred A. Mettler A.M., M.D. Ph.D. Philadelphia: The Blakiston Co. 1947

BLOOD DERIVATIVES AND SUBSTITUTES: PREPARATION, STORAGE, ADMINISTRATION AND CLINICAL RESULTS INCLUDING A DISCUSSION OF SHOCK. ETIOLOGY, PATHOLOGY AND MANAGEMENT. By Charles Stanley White M.D. Sc.D., and Jacob Joseph Weinstein, B.S., M.D. Baltimore: The Williams & Wilkins Co. 1947

THE FOOT AND ANKLE: THEIR INJURIES, DEFORMITIES AND DISABILITIES. 3rd ed. By Philip Lewin, M.D., F.A.C.S. Philadelphia: Lea & Febiger 1947

SURGICAL DISORDERS OF THE CHEST: DIAGNOSIS AND TREATMENT. By J. K. Donaldson, B.S. M.D., F.A.C.S. Philadelphia: Lea & Febiger 1947

HOOVER'S DISEASE AND ALLIED DISORDERS. By Henry Jackson, Jr., A.B. M.D. and Frederic Parker Jr. A.B. M.D., New York: Oxford University Press, 1947

DISEASES OF THE NOSE, THROAT AND EAR. By William Lincoln Ballenger, M.D., F.A.C.S. and Howard Charles Ballenger M.D. F.A.C.S. Assisted by John Jacob Ballenger B.S., M.D. Philadelphia: Lea & Febiger 1947

CORRESPONDENCE

ABUSE OF THE TERM SUBTOTAL GASTRECTOMY*

GASTRIC resection for duodenal ulcer has gradually replaced gastroenterostomy which used to be the operation of choice for this condition up to about 20 years ago. In gastric resection for duodenal ulcer about two thirds of the stomach should be removed. In Europe this operation is defined simply as resection of the stomach. In this country the term 'partial gastrectomy' was employed for many years and still is used by many leading clinics. Partial gastrectomy is the proper term for this type of operation. For some unknown reason many clinics in this country have adopted the wrong term 'subtotal gastrectomy' for this procedure. The unjustifiable misuse of the term 'subtotal gastrectomy' has reached such wide proportions that it seems proper to call a halt to its further abuse in connection with gastric resection for duodenal ulcer.

The term, "subtotal" implies that practically the whole organ is removed and that only a tiny rest of this organ is left behind. Thus in a properly executed subtotal thyroidectomy a minute remnant of the organ remains *in situ*.

Proc Mayo Clin 947 257

An operation analogous to this type of thyroidectomy is performed when gastric resection for a large gastric ulcer occupying most of the stomach is undertaken. After the removal of such a large gastric ulcer the stomach represents a small pouch composed mainly of part of the fundus.

These extensive gastric resections for large gastric ulcers luckily represent a very small percentage among the operative procedures on the stomach. They have one great disadvantage in their post-operative picture namely the annoyance which the small remaining stomach gives to the patient, at least during the first 6 months after the operation. Thus subtotal gastrectomy should be performed only as an operation of necessity in the presence of large gastric ulcers.

Gastric resections for duodenal ulcers which usually comprise about two-thirds of the stomach, should therefore never be classified as subtotal gastrectomies. They should be called partial gastrectomies. If every surgeon before classifying the gastric operation performed for a duodenal ulcer would remember the picture of a subtotal thyroidectomy the unjustifiable use of the term, "subtotal gastrectomy" for gastric resections for duodenal ulcers would soon be abandoned completely.

RICHARD L. GREEN

January, 1948

SURGERY GYNECOLOGY AND OBSTETRICS

Supplement

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COLLECTIVE REVIEW

CARCINOMA OF THE PARATHYROID GLANDS

With a Preliminary Report of 3 Cases

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IN 1926 Herzheimer and in 1933 Jaffe doubted the existence of primary carcinoma of the parathyroids and even today in the minds of many the question as to whether malignant epithelial tumors arise in the parathyroid glands is debatable. On the other hand isolated reports of tumors thought to be examples of this lesion have continued to appear in the literature during the last 40 years. Indeed, malignant tumors of the parathyroids have been described (although in fewer numbers) for almost as long as have the benign tumors that arise in these glands. Certainly the enigma of the situation can be solved only by an objective analysis of all of the available, relevant information. The problem here is one of practical clinical and surgical importance as well as one of fundamental scientific interest from oncological and endocrinological points of view.

With such knowledge as we now possess the recognition of primary carcinomas of the parathyroid glands is still beset with difficulties. In the first place parathyroid cancer is undoubtedly rare and this militates against the formulation of authoritative opinion. In the second place thus far there seems to have been no attempt to define the characteristics of this particular neoplasm. This state of affairs imposes upon the problem a degree of uncomfortable uncertainty that can be overcome only by further study in the hope that a modicum of clarification may eventuate. As with any other problem, at least to a certain point the

findings will be valuable in proportion to the quantity and quality of the data used in the study perhaps the quantity and quality of available data on parathyroid cancer are too limited to permit much progress. The present study however may at least assist in defining pertinent problems. Because the data are meager no apology is made for the necessity of relying more heavily upon judgment than would be permissible in the face of more ample material it is recognized that such conclusions as are reached may or may not stand in the light of more ample material.

Our investigation has been greatly facilitated by personal observations made in the study of material from 4 cases. Since the material from 3 of these cases has not yet been reported in the literature our findings are presented following the review of the literature and these cases have been added as the last 3 in Table I.

REVIEW OF THE LITERATURE

In Table I the cases that have been reported in the literature as parathyroid carcinomas, about which more or less individualized data are given, have been assembled. In this table the cases are listed chronologically and on the basis of our opinion they have been designated as those that are almost certainly examples of parathyroid carcinoma (+) those that are doubtful (?), and those that appear to have been mistakenly regarded as examples of this tumor (o). This sorting of the cases has been done because at best the amount of material is limited, and because if a satisfactory picture of parathyroid cancer is to

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evolve, the data for each case must be adequate and convincing if they are to be accepted for use in defining the characteristics of this tumor. Subsequently the criteria employed in classifying the individual cases will be presented.

Table I includes 41 cases that have been regarded as malignant parathyroid tumors by the original essayists. Fifteen cases (Nos. 8, 9, 16, 17, 18, 19, 21, 22, 23, 25, 26, 27, 39, 40, 41) have been classified as carcinomas of the parathyroid. 3 (No. 11, 14, 20) have been classified as questionable examples, and 23 (No. 1, 2, 3, 4, 5, 6, 7, 10, 12, 13, 15, 24, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38) have been included in a group that appears to have been mistakenly regarded as parathyroid cancers. Of this last group it is interesting to note that 7 were instances reported in the year 1907, they came from a period when the general classification of tumors was being elaborated and from a time prior to the clearer delineation of the characteristics of many neoplasms. Specifically and individually 10 of the cases of this group have been omitted from the group of parathyroid cancers because for each the description given is meager or not convincing as to the parathyroid origin, or it seems to indicate a different source. Case No. 15 was called a malignant adenoma, but quite apparently it was an example of benign parathyroid adenoma. In our opinion the same is true for cases No. 28 to 38, inclusive, and more has been written regarding this latter group in the discussion.

The 3 cases assigned to the doubtful group offer greater difficulties in diagnosis but, as will be seen, there are features about each report that cause a high degree of uncertainty. In case No. 11 the diagnosis was made from a biopsy of a metastatic lesion and the supposed primary cervical tumor was never seen. In the record of case No. 14 a diagnosis of parathyroid adenoma was made of the original tumor while the histologic examination of the recurrent lesions showed wildly growing epithelial cells that produced no characteristic pattern. The report of case No. 20 includes no description of histologic structure, although 1 illustration is presented; the tumor was designated as carcinoma, grade 1, but it may have been a benign adenoma of the parathyroid. The histologic structure as illustrated and the excellent post-operative clinical result argue for the benign nature of this tumor.

There remain 15 cases that seem acceptable examples of parathyroid carcinoma, and before we enter upon a discussion of the findings in this material it will be well to review each of these 15 cases. This will be helpful for it must be admitted

that, even in this selected group, widely differing values are attached to particular cases. In the succeeding review, therefore, the cases, having been compared and weighed, are arranged according to our judgment in approximately the order of their decreasing value: those that have been most completely studied and that, for our present purposes, possess a high value are presented first. The prior position accorded the first 3 cases will certainly not be disputed; however the exact position of each of the next 9 cases is debatable. Indeed, for each of these 9 cases one would have liked to have had a fuller account; they have been accepted because they were called carcinomas, because such data as are given seem to support the claim of parathyroid origin, and because no substantial reason could be found for denying them place. The 3 cases that are being reported preliminarily are placed last in order that they may be presented as a group of new cases. The 15 cases are numbered serially in this review but to prevent confusion the serial number assigned to each case in Table I is also given in parentheses.

REVIEW OF REPORTED CASES

Case I. (No. 25.) Between the years 1939 and 1943, 4 reports were made on the case originally described by Meyer, Rodi, and Ragins in 1939 (No. 25). The prior appearance of the report and the quality and completeness of the record justify placing this case first for it is probably the most classical example of parathyroid carcinoma thus far described.

A man of 56 years came under observation complaining that for about 7 months he had suffered with a painful swelling in the proximal portion of his right little finger. He further stated that he had fractured his left humerus following a fall and that he had lost much weight in the past 6 months. In the physical examination a firm tumor the size of a walnut was palpated in the right lower part of the neck anteriorly. The blood calcium and phosphorus were 15.9 milligram per cent and 3.1 milligram per cent, respectively, and the blood phosphatase showed 22 Bodansky units. X-ray examination revealed multiple bone lesions characteristic of generalized osteitis fibrosa cystica, and renal calculi. Biopsy of the lesion in the right little finger showed the picture of osteitis fibrosa.

At operation an encapsulated tumor measuring 6 by 4 by 4.5 centimeters was removed from the right side of the neck. On section the tumor tissue was light tannish gray in color. Microscopically, the tissue was disposed in anastomosing cords and alveoli, and various cell types characteristic of the

TABLE I—CHRONOLOGICAL ARRANGEMENT OF CASES CALLED PARATHYROID CARCINOMA IN THE LITERATURE

Series Number	Year	Author	Carcinoma + ?	Sex	Age	Hypercalcemia	Hypophosphatemia	Skeletal Changes	Renal Changes	Location of Tumor	Size of Tumor in cm.	Invasion and Metastases					Remarks
												Local Invasion	Lymph Nodes	Lungs	Liver	Bones	
	1907	Kocher		F	6						10x12x3	+	+				Had goiter for many years. Tumor in midline of neck.
	1907	Kocher		M	48					L—	8x7x5	+					
3	1907	Langhans		M	46						small						Had goiter for many years. Tumor near thyroid. Local recurrence. Histology suggests giant cell carcinoma of the thyroid.
4	1907	Langhans		M	48						8x7x5					+	Tumor in midline of neck.
5	1907	Langhans		M	50					L—	2x2x2		+				Histology suggests giant cell carcinoma of thyroid.
6	1907	Langhans		F	54					L—	First size						Postoperative recurrence of tumor
7	1907	Langhans		M	33						0.5	+	+				Histology suggests carcinoma of thyroid
8	1909	deQuervain	+	M	68					R—	6 g	+	+	+	+		Local recurrence of tumor. Histology seems typical of parathyroid.
9	1914	Roffo and Landivar	+	M	60					LL	very large		+	+	+		Extension of tumor into mediastinum. Histology stimulates parathyroid.
	1913	Faenzi		F	63					L—	10	+					Invasive thyroid. Histologic structure not convincing of parathyroid origin.
	1915	Ferrero and Sacerdote	?	F						R—	small mass					+	Supposed primary cervical tumor not recovered. Diagnosis made from biopsy of metastasis in temporal bone. Too indefinite to be given parathyroid origin.
	1916	Hendrick		F	7												Retracted tumor. Also tumor in upper pole of thyroid. Both tumors surrounded by thyroid tissue. Histology suggestive of giant cell carcinoma of thyroid.
13	1917	Alessandri		M	5			+								+	No cervical or primary tumor found. Diagnosis made from biopsy of lesion in bone. Too indefinite to be given parathyroid origin.
14	1919	Guy	?	F	50					LL	2x2x4			+			Local recurrence 2 months after operation. X-ray evidence of pulmonary metastasis 14 years after operation. Histology not typical of parathyroid origin.
15	1919	Wellsbeck (Wilker)		F	3	+	+	+		R—	5x3 5x3	-					Called malignant adenoma. Prompt recalcification of bones postoperatively. The patient died 1 year after removal of the parathyroid tumor. Autopsy showed an epidermoid carcinoma of the esophagus and no evidence of parathyroid tumor. (The late note on this case in paper by Alexander <i>et al.</i> , 1944.)
16	1921	Toland	+	F	60					RU	Large mass	+		+			Goiter for 8 years. Cervical mass and right lobe of thyroid removed. Death 4 months after operation from pulmonary metastases.
17	1921 1923	Bourguignon, Salmon, and Millet	+	M	35	+	+	+		LL	walnut	+					Following second operation, at which time nodule thought to be recurrent tumor was removed, the patient's symptoms improved.

INTERNATIONAL ARRANGEMENT OF CASES CALLED PARATHYROID CARCINOMA
TABLE I.—CHRONOLOGICAL ARRANGEMENT OF CASES CALLED PARATHYROID CARCINOMA
IN THE LITERATURE—Continued

Series Number	Year	Author	Carcinoma + ?	Sex	Age	Hypercalcemia	Hypophosphatemia	Renal Changes	Location of Tumor	Site of Tumor in Gland	Invasion and Metastases					Remarks
											Local Invasion	Lymph Nodes	Lungs	Liver	Bones	
18	1923	Price and Mowat	+	M	40				L.U.	Ham's egg	+		+			Following operation the tumor is cured and spread occurs through the skin. Endocrine structure characteristic of parathyroid.
	1924 1940	Hall and Chaffin	+	M	36				L—	caps	+	A	A		A?	Local recurrence 14 months after operation. Patient well in 18 months after second operation. Died 4 years after second operation. Anterior chest metastases in bones and lymph nodes. No gross evidence of tumor but areas of necrosis by x-ray were interpreted as metastases.
19	1936	Sami	?	M	47	+	+	+	RL	caps						Called carcinoma, grade I. Found and excellent postoperative improvement with recalcification of bones.
	1937	Petersen	+	M	37	+	+	+	R—	chestnut	+					Called malignant adenoma. Postoperative recalcification of bones. Tumor tissue had invaded the capsule and vein. Tumor tissue suggests parathyroid origin.
	1938	Armstrong	+	F	71				R—	ls capsule	+					By x-ray another tumor was seen in the mediastinum. Tumor is not suggestive parathyroid origin.
2	1938	McQuillen	+	F	33	—	—	—	R—	golf ball	+					Two local recurrences in 1946 following first operation. Histologic structure typical of parathyroid.
3	1939	Mackinnon		M	46				LL	supr. larynx's head	+					Although the author describes the outline of the thyroid lobes, the histology of the tumor suggests parathyroid carcinoma of thyroid.
4	1939 1940 1941 1942	Meyer, Rapson, et al.	+	M	35	+	+	+	R—	caps	+	A	A			Temporary improvement with normal blood calcium level for 1 month postoperatively. Died 2 years after operation. Recurrent tumor 3 months after operation with return of hypercalcemia. Autopsy (A) showed extensive metastatic disease and metastatic lymph nodes, lungs and kidney.
5	1939 1940 1941 1942	Meyer, Rapson, et al.	+	M	35	+	+	+	R—	caps	+	A	A			Temporary improvement with fall of blood calcium level postoperatively. Return of symptoms and hypercalcemia with recurrence of cervical tumor. Second tumor is metastatic. Involvement of lymph nodes removed and patient has remained well for 1 year; bones have recalcified.
16	94	Gracie, Blumner and Ashburn	+	M	38	+	+	+	L—	caps	+	+				Observed for only 1 month postoperatively. Histology of tumor stimulates parathyroid.
17	94	Mondala	+	F	33				L—	S	+					Good health 1 year after removal of tumor.
18	94	Alexander et al (Case 3)		M	34	+	+	+	R—	2x 2x 2x						Patient died on 17th postoperative day.
19	1944	Alexander et al (Case 4)		F	30	+	+	+	R—	2x 2x 2x						Parathyroid tumor removed.
20	1944	Alexander et al (Case 5)		F	3	+	+	+	RL	caps						

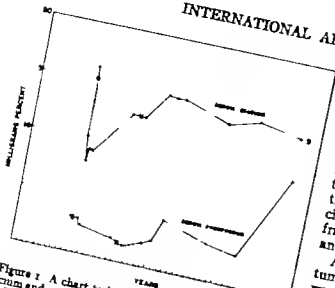


Figure 1. A chart to indicate the effect upon the serum calcium and serum phosphorus values as they were affected by the removal of the original tumor and by the development of the recurrent lesion. Chart constructed from data published by Meyer and Ragins, 1943. X=recurrent tumor discovered, D=death. O=operation

per cent and the blood phosphorus level was 1.00 milligrams per cent. On physical examination, a hard nodule about 3 centimeters in diameter was discovered in the region of the right lobe of the thyroid gland; this nodule seemed fixed to the jugular vein and carotid artery. X-ray therapy was ineffectual and the patient's condition became progressively worse until he died 3 years and 8 months after the onset of symptoms.

During these years the blood chemistry was followed up and gave the striking picture shown in Figure 1. Note the precipitous fall of blood calcium following the first operation and its gradual return to a high level with the development of the recurrent tumor.

At autopsy there was a recurrent tumor in the right side of the neck which invaded the adjacent tissues; metastatic tumors were found in the tracheal, subclavian, and perijugular lymph nodes, in the lungs, and in the right kidney; there was diffuse osteitis fibrosa cystica involving practically all the bones of the body; there was renal, parathyroid, and renal calculi were present. The microscopic findings in the recurrent tumor and metastatic lesions were the same as those of the original cervical tumor.

Case II. (No. 26). Except for the fact that it was not followed to autopsy the second case (No. 26) is most thoroughly described and certainly is of value equal to that of Case I. In 1941, Gentile and Ashburn reported the case of a man 38 years old, who came under observation because of "broken legs." For 18 months previously he

had suffered with pains in his bones; he had come slowly and progressively weaker and he lost weight. Polyuria had been present for years. Just prior to the mentioned accident a lump had appeared in the left side of his neck. The blood calcium was 14.7 and the blood phosphorus 3.1 milligrams per cent. The phenolsulfonphthalein test totaled 30 per cent after 2 hours. The Moscovitz concentration test showed the greatest specific gravity to be 1.007. The x-rays revealed fractures of both femurs and the right humerus, and a generalized demineralization of the bones.

At operation a hard, reddish brown, nodular tumor (5 by 3 by 3 cm.) was removed; the tumor was densely adherent to the thyroid. The diagnosis from the microscopic study of this tumor was adenoma of parathyroid (malignant?). Immediately after the removal of this tumor, the blood calcium fell rapidly to below the critical level; apparently tetany was prevented by the administration of calcium and viosterol. Gradually the blood calcium level returned to normal.

During the succeeding 3 months the patient's general condition and the state of the bones improved. Then his weakness and body pains returned and the blood calcium rose to a level above normal and the blood phosphorus level was lowered. The cause of this altered clinical state was not discovered until nearly 10 months after the first operation, when an enlarged cervical gland was noted in the left side of the neck. This gland was removed; microscopic examination showed metastatic involvement of a lymph node by a malignant epithelial tumor and a diagnosis of malignant adenoma of the parathyroid gland with metastasis was made.

After removal of the metastatic gland, the blood chemistry returned to normal levels. The fractures healed rapidly and some of the cystic areas of the bones became more densely filled with calcium. The case was followed up for 5 years after the first operation.¹ Following the second operation the patient's general condition again improved, his fractures healed solidly, the bones recalcified, and even the large cystic areas were nearly filled by calcium at the end of 5 years. In Figure 2 the blood calcium and blood phosphorus levels are shown as they were affected by the first and second operations.

The microscopic pathology of the tumor is so important and so well presented that the original description is quoted as follows: "Left parathyroid (the tumor) has a thick, densely fibrous capsule and trabeculae, which show patches of lymph-

¹The late follow up on this case is described in footnote in Gentile et al., (9)

NORRIS CARCINOMA OF THE PARATHYROID GLANDS

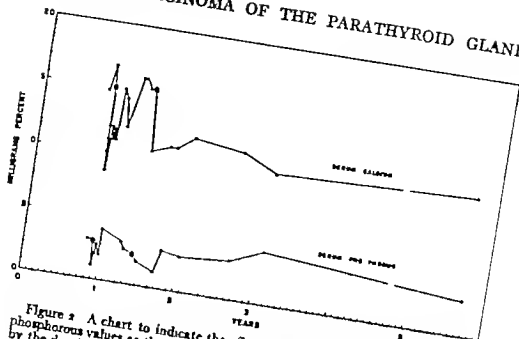


Figure 2. A chart to indicate the effect upon the serum calcium and serum phosphorus values as they were affected by the removal of the original tumor by the development of the recurrent lesion, and by the removal of the recurrent tumor. Chart constructed from data published by Gentile, Skinner and Ashburn 1941. O=operation.

ocyte and plasma cell infiltration, an occasional small area of calcification and few foreign body granulomas in which large angular spaces occur presumably cholesterol clefts. The parenchyma is formed of large and small sheets the nests and columns of cells enclosed by or embedded in the dense fibrous tissue. Tumor cells are polygonal and medium to large in size. They have much reticulogranular oxyphilic to amphophilic cytoplasm with distinct cell borders. Nuclei are medium to large in size vesicular usually centrally located commonly have one or more large nucleoli and are moderately and occasionally markedly hyperchromatic. Mitoses are present. One medium sized venous channel shows invasion of its wall by an adjacent tumor nodule. In many areas small poorly circumscribed cell nests occur and few of these show infiltration of the surrounding fibrous tissue. The larger cell sheets occasionally show focal coagulation or karyorrhectic necrosis.

Little striated muscle and less thyroid tissue is adherent to capsule.

Diagnosis Adenoma of parathyroid (malignant?)

The description of the histopathology of the recurrent cervical nodule removed at the second operation follows. The 8 by 11 mm tumor mass is enclosed in a dense layer of scar tissue which is thicker where it gives rise to trabeculae which completely or incompletely lobulate the tumor. The fibrous tissue shows patches of lymphocytes and little scattered free and phagocytosed hemo-

siderin. Parenchyma is formed of large and small sheets and strands of coherent tumor cells which are polygonal medium to large in size, and have distinct cytoplasmic margins. Cell nuclei are moderately hyperchromatic, and show one or more distinct usually large nucleoli. Few mitoses are seen. Cell cytoplasm is ample granular and oxyphilic, less often amphophilic. Tumor cells immediately surrounding blood vessels are usually larger than elsewhere and roughly columnar and show irregular radial arrangements. Few cell sheets show focal coagulation necrosis. A small collapsed cyst present in peripheral fibrous layer is lined by budlike masses of vascular granulation tissue. In some of the vascular spaces there are masses of tumor cells some apparently lying free while others are loosely adherent to wall. In some of these vessels there is little blood. Occasionally a tumor mass occurs in a larger vessel.

A small lymph node loosely attached to tumor shows moderate sinus endothelial proliferation. A second detached node shows in addition a vascular space filled with tumor cells.

Diagnosis Malignant adenoma of parathyroid gland, metastatic.

In 1934 and again in 1940 Hall and Chaffin recorded their observations in the third case (No 19) that of a man who came under their attention when 46 years of age. Five years previously he had first noted a small lump in the left side of his neck, which gradually increased in size. The patient experienced increasing difficulty in swallow

ing and breathing and he suffered frequent brief attacks of palpitation. There was no loss of weight and he had remained at his work. The principal physical finding was a moderately adherent mass, the size of an orange extending from the left side of the neck to beyond the midline. At operation this mass of liverlike tissue measuring 10 by 7.5 by 5 cm. was removed together with the left lobe of the thyroid to which it was attached. The pathologic diagnosis was adenoma of the parathyroid. (See description of the histopathology quoted in following paragraphs.) The blood chemistry had not been studied preoperatively 10 days postoperatively the blood calcium level was 9.9 milligrams per cent, and roentgenograms of the long bones gave normal findings.

About 16 months after the first operation the patient noted a small nodule immediately beneath the skin in the left side of the neck which gradually increased in size. Examination of the neck revealed the presence of 2 other smaller subcutaneous nodules. These nodules were removed and the pathologic diagnosis was recurrent carcinoma of the parathyroid.

The patient was observed for 3 years following the first operation and during this time the only incident was the local recurrence in the neck. The blood calcium and phosphorus levels were normal and roentgenograms of the skeleton showed no pathology of the bones.

Microscopic Examination (of original tumor) The mass presents the structure of a parathyroid gland. It is made up of columns and groups of small cells having faintly granular cytoplasm and relatively dark staining vesicular nuclei. These are the 'small dark chief' cells of Cowdry. Scattered among the columns are a few groups of larger 'clear chief' cells and also a few oxyphilic cells. The greater number of cell columns and groups are solid but a few are tubular or alveolar where seen on cross section. Some of these contain faintly staining homogeneous material resembling colloid. A few areas of necrosis are scattered throughout the section. Dividing the cell columns is a fine reticulum of connective tissue containing blood vessels.—**Diagnosis** Adenoma of parathyroid.

Microscopic Examination (of the recurrent lesion) Sections taken from various parts of the tumor show anastomosing cords and columns of somewhat atypical epithelial cell which in places invade the surrounding muscles, while in other parts the tumor is limited by a fibrous capsule. Here and there fairly broad bands of cellular fibrous tissue transverse the tumor. In a number of places large cell masses appear in which the

alveolar arrangement is not very evident. The nuclei of the epithelial cells are round or oval, vesicular and moderately deep staining. They contain one large and often one or two small nucleoli. The nuclei are variable in size, some of them appearing quite large. Occasional mitoses are seen. The cells are polygonal in shape and the cytoplasm is finely granular, fairly abundant, and moderately eosinophilic. Occasional small groups of cells are found in which the cytoplasm is dense. Other groups of cells which tend to be elongated or fusiform have hyperchromatic nuclei and more deeply staining cytoplasm. These cells have a loose, nondescript arrangement and appear to be distinctly atypical. When stained by Mallory's eosin-methylene blue method, these cells have eosinophilic granules in their cytoplasm while the nuclei stain a very deep blue. These are the oxyphil cells of Welch.

The small separate nodule from the right side of the neck shows invasion of the skeletal muscle.

In several places masses of tumor cells are found in the small and medium sized veins of the stroma. Other cell groups about the borders of the tumor appear to be in the lymphatic vessels.

Diagnosis Recurrent carcinoma of the parathyroid.

Toland, in 1931, reported the fourth case (No. 16) that of a woman 60 years of age who for 8 years had noted an enlargement in her neck. During the 3 months prior to coming under observation the swelling increased rapidly in size and dyspnea and dysphagia developed. At operation a large mass involving the upper pole of the right lobe of the thyroid gland was removed. The pathologic diagnosis was adenocarcinoma of the parathyroid. The patient died 4 months after the operation from pulmonary metastases. Despite the brevity of Toland's report the published illustrations of histologic structure seem convincing of the parathyroid origin of this tumor.

Roffo and Landivar recorded the fifth case (No. 9) that of a man 60 years of age who for 35 years had noted the presence of a nodule the size of a nut in the lower left side of his neck. This nodule gave no symptoms but had grown slowly to the size of an ostrich egg during the past year. The tumor was resected at operation but the patient became more and more cachectic and died 3 months after the operation. At postmortem, metastases were found in the lungs, liver and lymph nodes.

Microscopically the structure of the metastases resembled that of the primary tumor. The tumor was made up of small masses and nests of cells that in places were arranged in the form of small

follicles. The cells had polygonal outlines and definite cell walls. The general structure and the types of cells gave the picture of parathyroid tissue.

Case VI. (No 8) In 1909 de Quervain described the sixth case (No 8) which may be the earliest recorded case of a parathyroid carcinoma. The patient was a man 68 years of age, who had noted a painless swelling in the right side of his neck for 1 or 2 months. The cervical tumor measured 6.5 centimeters in diameter was removed at operation but the patient developed bronchopneumonia and died. At autopsy a tumor mass, 5 centimeters in diameter was found in the thoracic aperture. In addition, metastases were found in the cervical lymph nodes in both lungs, and in the liver.

Grossly the tumor was a round, nodular encapsulated mass. The tumor tissue was gray in color and no necrosis was seen. Microscopically of the epithelial elements were arranged in the form of irregular narrow strands. The cells were sharply outlined polygonal structures like those of the parathyroid.

Peterama (1937) recorded the seventh case (No 21) that of a man 31 years of age who had suffered for some years with body pains. Roentgenograms showed the bony changes of osteitis fibrosa. In the right side of the neck there was a firm nodule. At operation a tumor mass the size of a chestnut was removed from near the right lobe of the thyroid. After a year the condition had improved and the patient's bones showed so much recalcification that he was considered cured.

The author seems uncertain as to whether this tumor arose from the thyroid or parathyroid however the published illustrations support the parathyroid origin as do also the description of the skeletal changes and the postoperative recalcification of the bones. The author calls this tumor a malignant adenoma in his illustrations, however he shows tumor tissue in the lumen of a vein. Bourguignon and Santon (1931) and later Santon and Millot reported the eighth case (No 17) that of a man 35 years of age who had had skeletal deformities since childhood in the flat bones the disease resembled Paget's disease and in the long bones it was like von Recklinghausen's disease. When seen at the age of 35 the blood calcium level ranged from 13.7 to 15.0 milligrams per cent. The right and left inferior parathyroid glands were removed the right gland was normal but the left one was hypertrophied and weighed 211 milligrams. This large parathyroid was considered a typical adenoma. Following the operation there was no improvement in the pa-

tient's condition in fact, the osteitis fibrosa and the metastatic calcification increased.

After more than 2 years the patient was operated on again the superior glandules were not found but a hard nodule the size of a walnut was discovered on the surface of the thyroid near its left lower pole. This nodule was considered to be a recurrent lesion. In this tumor the histologic picture resembled that of the adenoma removed previously. The published illustrations of the histological findings seem convincing of the parathyroid origin of this tumor.

McQuillan in 1938 presented the ninth case (No 23) that of a woman 53 years of age who had noted a swelling in her neck for 2 years. At operation an encapsulated tumor the size of a golf ball adherent to the trachea and the right lobe of the thyroid, was found. The tumor was yellowish brown in color and had the consistency of liver. The histologic structure of the tumor resembled that of a parathyroid adenoma. It was made up of nests and cords of cells which were arranged in broad sheets in which very little stroma was present. The epithelial cells resembled those of the parathyroid.

Two years following the first operation the patient presented herself with a small, firm nodule involving the skin and subcutaneous tissue in the right side of her neck. The physical findings were otherwise negative. This nodule, which was adherent to the jugular vein, was excised. It was a ragged, nonencapsulated mass of soft yellowish gray tissue composed of large clear cells. A diagnosis of parathyroid adenoma was made with the comment that it does not appear to be highly malignant.

Despite roentgen therapy at the end of 3 months 2 more nodules appeared in the neck. At this time x ray examination of the complete skeleton gave normal findings and the blood calcium and phosphorus levels were normal.

Price and Mowat reported the tenth case (No 18) that of a man aged 49 years, who 8 years previously had noted a small lump about the size of a grape on the left side of his neck. This lump grew rapidly in the 3 months before its surgical removal. At operation an encapsulated but adherent tumor the size of a hen's egg was removed. A deep portion of the tumor that was infiltrating the wall of the carotid artery had to be left. The tumor recurred as an ulcerated fungating mass and spread over the chest and into the axilla.

Microscopic sections showed that it was made up of strands and sheets of cells resembling those of the parathyroid in places, tiny follicles were present some of these contained colloid

Armstrong in 1938 reported the eleventh case (No. 22) that of a woman 71 years of age who complained of a painless swelling which had first appeared on the right side of her neck 4 months previously. This swelling at first small had gradually increased in size. There were no other important clinical findings. The tumor measuring 11 by 11 by 4 centimeters, was removed; it was quite separate from the thyroid, but adherent to many adjacent structures. The microscopic structure resembled parathyroid tissue; there were cords and strands of epithelial cells with some tiny follicles filled with colloid. A diagnosis of carcinoma of the parathyroid was made.

By roentgenography of the chest the presence of a mediastinal tumor was identified.

Mendiola reported the twelfth case (No. 27) that of a woman, 32 years of age, who first noticed a painless swelling in the left side of her neck at the level of the thyroid. This tumor grew slowly for 8 months until it was about 5 centimeters in diameter. There were no other physical findings and the skeletal system showed no pathology.

At operation the tumor was found to be adherent to and infiltrating the adjacent muscles. Three months after the operation, which was followed by x-ray therapy, the general condition of the patient was good and there were no signs of metastases or local recurrence.

The tissue removed had no capsule and consisted of grayish white soft tissue. Microscopically it was made up of columns and nests of cells like those of the parathyroid. In some places the blood vessels had been invaded by the tumor tissue. Some small areas of necrosis were encountered.

PRELIMINARY REPORT OF 3 CASES, WITH PERSONAL OBSERVATIONS OF THE HISTOLOGY IN 4 CASES

In the files of the Department of Pathology of the Massachusetts General Hospital there are sections from 4 cases that have been sent in for study from other clinics. One of these is a section from that most significant case reported by Meyer Rosal and Ragins. The other sections are from 3 other cases, and it is planned that each of these 3 cases will be reported in full by the original observers. We have studied the histology of each of these tumors and have been privileged by the original observers, in each of the 3 new cases, to include herewith a brief preliminary statement.

Case of Meyer Rosal and Ragins Case 1 (No. 25). A single section, measuring approximately 3 by 2 centimeters on the slide, was studied. Our general findings in this tumor are in accord with the published description by the original authors, as summarized. The availability of tissue from

this well established case has been of great importance to us, for it provides a histologic criterion by which other cases may be judged. Because of the significance of this case our own histologic observations of this lesion, together with our comments, are presented in the ensuing paragraphs.

In the section the tumor appears to be completely surrounded by a false capsule of connective tissue which seems to have been formed by the agglomeration of the dense stromal bands that have been encountered by the tumor in its expansive growth. Septa of varying density arise from this pseudocapsule and divide the tumor into lobules of irregular form and variable size. In the larger lobules there is a relatively small amount of stromal connective tissue within the lobules.

It is our opinion that these relationships of the stromal and parenchymal parts hold the explanation of a very important feature in the gross and surgical pathology of this tumor. Notably in certain peripheral parts of the tumor relatively delicate cords of epithelial cells are seen infiltrating the capsular stroma; these infiltrating cords demonstrate the invasive nature of the growth, and from such histologic pictures the tendency of the lesion to be adherent can be understood. It seems probable that as time passes, these tiny peripheral cords may increase in size, by the multiplication of cells, to form the more massive lobules characteristic of the deeper portions of the tumor. However, even in the larger lobules the cells are disposed in the form of anastomosing cords or masses that vary from 1 to 4 cells in thickness, and are separated by capillaries and/or stromal connective tissue fibers.

Typically the epithelial cells are relatively large polyhedral structures with distinct cell walls. The cytoplasm is made up of fine eosinophilic or amphophilic granules, and vacuoles of variable size may be present. The nuclei are round or bluntly ovoidal, vesicular bodies that almost uniformly contain 1 or even 3 prominent nucleoli of varying size. Very few mitoses are seen.

In their initial paper (1939) Meyer Rosal and Ragins considered this tumor to be "a nonhornifying squamous cell carcinoma of the parathyroid gland; however in their later papers (1941, 1943) the thought of its squamous cell nature is no longer emphasized. From the point of view of our present effort to define the characteristics of the parathyroid carcinoma, the original diagnosis in this case is of importance. Although we can understand how the large cells and the blunt lobular arrangement suggest a squamous cell carcinoma, it is our opinion that this is not the fundamental nature of



Figure 3 Roentgenogram of skull taken prior to operation to show the marked demineralization and the cystic areas of decalcification (Case XIII)

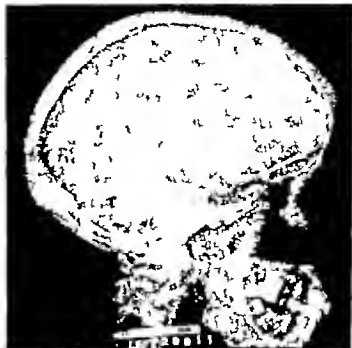


Figure 4 Roentgenogram 4 months following operation to show the striking degree of postoperative remineralization and recalcification of cystic areas (Case XIII)

the neoplasm. A careful search failed to demonstrate convincing intercellular bridges that could not be better interpreted as artifacts or involutional changes. Certain parts of the tumor are undergoing necrosis, and granules of calcium are present in considerable numbers in both the viable and necrotic portions.

Through the courtesy of Alton R. Kilgore of San Francisco we are privileged to refer to a case operated on by him—Case XIII (No. 39). Kilgore and Taylor plan to publish a full report at a later date when more postoperative data are available. Kilgore and Taylor are to be congratulated upon the careful and thorough manner in which this case was handled, and for the study that included nearly daily postoperative determinations of blood calcium levels and a bio-assay of the tumor.

The patient, a woman 51 years of age, had noted a lump in her neck for 10 years, and had developed the classical symptoms of hyperparathyroidism (rheumatic pains, weakness, anorexia, nausea, occasional vomiting, and loss of weight) during the 2 years prior to coming for examination. Roentgen studies revealed extensive demineralization of the bones and many areas in which destructive lesions were present in the skeletal parts (Fig. 3). Multiple small calculi were also demonstrated in the right kidney. Eighteen years previously the presence of a stone had been recognized in the right kidney. A biopsy of a rib lesion

showed the picture of a giant cell tumor. The serum calcium was 18.5, phosphorus, 5.0, alkaline phosphatase, 17.8.

The diagnosis of hyperparathyroidism was made. At operation 2 tumor masses were found back of the right lobe of the thyroid, the larger of these measured about 2.5 centimeters in diameter and was removed with difficulty for it was densely adherent to the adjacent capsule of the thyroid and to the recurrent laryngeal nerve; the smaller tumor (about 1.5 by 1.0 cm.) lay behind the vessels at the lower pole of the thyroid, was not adherent, and was readily removed.

A pathologic diagnosis of malignant tumor of parathyroid origin was made.

Bio-assay of the smaller tumor raised the blood calcium of a rabbit to 19 milligrams per cent from a preinjection level of 12 milligrams.

Postoperatively the patient's serum calcium fell to a low of 7.0 milligrams per cent (without tetany) and then returned to normal. During the first 3 months after the operation the patient gained weight, lost her symptoms, and felt well. Roentgenograms of the skeleton taken 4 months after the operation showed quite marked regression of the pathological changes (Fig. 4).

*Tissues removed at operation.*¹ Microscopic sections from 6 blocks of tissue were examined. One

¹The following description and interpretation of the histopathologic findings were made by the present author and are based upon sections furnished by Dr. Kilgore.

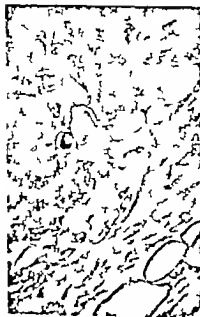


Fig. 5



Fig. 6



Fig. 7

Figure 5. Photomicrograph of a peripheral part of the tumor showing invasion of thyroid parenchyma. Certain thyroid follicles are surrounded by neoplastic tissue, while others are deformed by the expanding encroachment of the tumor. The cords and nests of cells that make up the tumor are seen. (X 100)

Figure 6. Photomicrograph of peripheral portions of the tumor (top) infiltrating thymic tissue (bottom). A part of a Hassall's corpuscle near the lower corner. (X 100)

Figure 7. Photomicrograph of an area in the tumor illustrating the lobular character of the tumor and the interlobular connective tissue septa. (X 95)

block represented a total cross section of the larger tumor. On the slide this tissue was ovoidal in outline and measured 8 by 17 centimeters. Three other blocks represented tissues from different parts of the larger and smaller tumors. The last 2 blocks apparently represented fragments of tissue removed while the larger tumor nodule was being dissected free. One of the latter blocks contained principally quiescent thyroid tissue that was being invaded by the tumor. The sixth block contained several tissues. There was a large mass of tumor tissue, on one surface of which a considerable amount of thymic tissue was being invaded by the tumor and nearby and nearly surrounded by thymic tissue, was a normal parathyroid glandule.

Histopathology of the tumor. The larger tumor was incompletely surrounded by a false capsule of connective tissue. This capsule varied in thickness and density in different places. On two opposite surfaces the capsule had been totally invaded by the tumor and from this appearance it was questionable whether the tumor could be removed completely. On one surface thyroid tissue was present in the capsule and here the follicles were being surrounded and deformed, apparently by the pressure of the encroaching tumor (Fig. 5)

and just outside the tumor capsule was a small nodule of normal thyroid parenchyma. At the opposite pole of the tumor mass, a bit of thymic tissue was incorporated within the fibrous capsule.

The fibrous tissue of this tumor was conspicuous, broad septa of dense connective tissue divided the parenchyma into masses or lobules of irregular size and form (Fig. 7). Under low power magnification these septa gave a false impression, suggesting that the tumor was constructed of sheets of epithelial cells that formed the lobules (Fig. 7). However under higher magnification it was seen that from the broad septa relatively delicate strands of very vascular connective tissue coursed through the lobules; these strands dwindled rather soon leaving only the structures of a rich capillary bed to separate the epithelial elements (Fig. 8). In places, by delicate fibrillar connective tissue, and almost everywhere, by capillaries and sinusoids, the epithelial tissue of the lobules was divided into cords and nests of cells; these epithelial cords interlaced in an irregular manner and typically they tended to be 2 cells in thickness (Figs. 8 and 9). Even in those parts where broad sheets appeared to be present careful study revealed the tendency toward the formation of

NORRIS CARCINOMA OF THE PARATHYROID GLANDS



Fig 8

Figure 8. Photomicrograph of an area in the tumor to illustrate the winding of the connective tissue septa within the lobules and the cords and nests of epithelial cells from which the tumor lobules are made up. (X100)

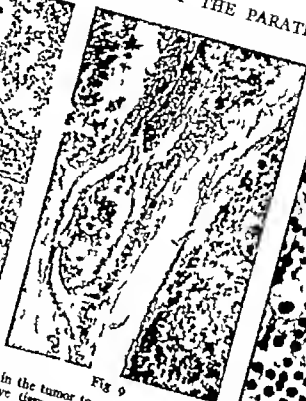


Fig 9

Figure 9. Photomicrograph illustrating the presence of attached masses of tumor tissue within the lumen of a septal blood vessel. In the right part of this figure the edge of a tumor lobule is seen. (X100)



Fig 10

Figure 10. Photomicrograph illustrating the character of the cells that make up the greater part of the tumor in the majority of tumors these are vesicular and dense cells. (X350)

epithelial cords. Although a few droplets of colloid were present, there was no tendency toward the formation of follicles.

The tumor had invaded adjacent thyroid and thymic tissue (Figs. 5 and 6) and showed a notable tendency to invade the blood vessels (Fig. 9).

Characteristically the epithelial cells were relatively large, polyhedral bodies that were outlined by distinct cell walls (Fig. 10). Some cells were vesicular but the majority were filled by a finely granular basophilic cytoplasm. In some areas dark cells predominated and an occasional oxyphil cell was present (Fig. 11). In certain parts the cells had departed from the more typical polyhedral form to assume columnar shapes (Fig. 12) around certain vascular spaces (Fig. 12) where they formed a pattern similar to that found in some benign adenomas of the parathyroid or at times in normal glandules. The nuclei of the tumor cells in general were round or ovoid, rather normally chromatic or somewhat hyperchromatic structures and most of them contained a prominent nucleolus. A few abnormally large nuclei were seen. Mitoses were scarce.

Through the courtesy of Monroe J. Schlesinger, Pathologist of the Beth Israel Hospital Boston

we are privileged to refer to the following case. It is planned that a full report of this case will be made by Drs. Ober and Meilman.

Case XIV (No. 40) of Ober and Meilman. The patient, a man 50 years of age complained of pain in both knees. Roentgenograms revealed cystlike destructive lesions in many bones. The serum calcium was 17 the phosphorus 2 the alkaline phosphatase 61. A tumor weighing 28 grams, was removed from the left side of the neck and the pathologic diagnosis was parathyroid adenoma. The patient's condition improved symptomatically and roentgenographically. About 1 year postoperatively the blood calcium had risen to 17 and a recurrent lesion was removed at operation. The pathologic diagnosis was carcinoma of the parathyroid. This second operation failed to correct the blood chemistry values. Four months later at the third and much more radical operation several tumor nodules were removed and the blood calcium fell from 15.8 milligrams per cent preoperatively to a low of 7.7 after the operation. Microscopic sections from each of the 3 operations were studied the comparison of these tissues was of importance for there was considerable difference between the histology of the original tumor and that of the recurrent lesions.



Fig. 1

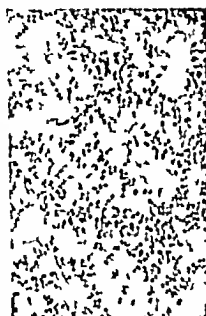


Fig. 2

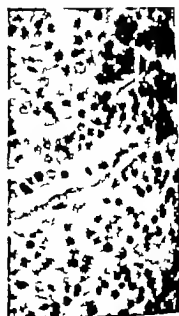


Fig. 3

Figure 1. Photomicrograph illustrating the character of the cells found in certain portions of the tumor: vesiculae dense and dark cells are present in this area. ($\times 50$)

Figure 2. Photomicrograph to illustrate a particular type of histologic pattern in which cells of columnar form are arranged around endothelial lined vascular spaces. ($\times 125$)

Figure 3. Photomicrograph of a typical area from the original tumor removed at the first operation. A mitotic figure is seen just to the left of the center of the field. The cells are disposed in the form of narrow anastomosing cords. Note the relatively small and uniform size of the cells, and the inconspicuousness of nucleoli. A moderate degree of variability in the size of nuclei is seen. ($\times 125$)

The tumor removed at the first operation had the structure of a compact parathyroid adenoma in which there was but a feeble attempt at lobulation. The polyhedral epithelial cells tended to be uniform in size; their cell bodies were filled with a finely granular eosinophilic cytoplasm in which vacuoles were rarely seen. The nuclei were round or ovoid, normally chromatic bodies, and in general most of them were of approximately the same size. Here and there, however, a moderately enlarged, hyperchromatic nucleus was found. Nucleoli were very inconspicuous and were found in relatively few cells. An occasional mitosis was seen.

Even in retrospect, except for the presence of mitoses, there was little in the histology of this lesion that could be recognized as different from what has been repeatedly seen in benign adenomas (Fig. 13).

The tumor tissues removed at the second and third operations were similar but they differed considerably from that recovered at the first operation. The lobular structure was definite; the lobules varied in size and shape and were more or less completely outlined by septa of dense connective tissue. The cords of epithelial cells were

definitely invading the walls of the blood vessels (Fig. 15) and some tumor thrombi were seen. On one surface of the tumor the parenchymal cords had grown between striated muscle fibers (probably esophageal musculature). The epithelial cells were widely variable in size; the majority had large polyhedral bodies outlined by distinct cell walls, and in these the nuclei showed a wide variability in size and considerable variation in the amount of chromatin (Fig. 14). The nuclei of these larger cells regularly contained 1 or even 3 prominent nucleoli that were variable in size. In other smaller areas the cells were not so large and tended to have small ovoid hyperchromatic nuclei.

Case XV (No. 41). Case of J. H. Young and Emerson.¹ The patient, a woman 53 years of age at the time of her operation, had been known to have had osteoporosis, with a serum calcium up to 15 milligrams per cent, for 12 years. At operation 2 tumor nodules, measuring 3.5 by 3 and 2.5 by 2 centimeters, respectively, were removed from the left side of the neck. Following the operation the patient was symptomatically improved and the serum calcium was normal for 3 years. The

¹Case from the Peter Bent Brigham Hospital.



Fig 14



Fig 15

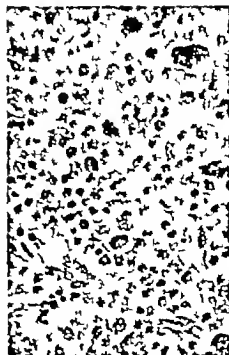


Fig 16

Figure 14. Photomicrograph of a typical area from the recurrent tumor removed at the second operation. This figure should be compared with that shown in figure 12: the cells are larger, more loosely arranged, and more of the nuclei contain prominent nucleoli. ($\times 375$)

Figure 15. Photomicrograph of an area from the recurrent tumor removed at the third operation. Dense septal

connective tissue fills the greater part of the field. Note the invasion of this connective tissue by cords of tumor cells and the presence of tumor tissue within the lumen of a vessel. ($\times 100$)

Figure 16. Photomicrograph of an area from a benign parathyroid adenoma to show the character of the cells and the presence of huge hyperchromatic macronuclei. ($\times 375$)

serum calcium again became elevated and the patient died of renal insufficiency at the age of 59 6 years following the operation. At autopsy there was a recurrent tumor at the site of operation but no metastases were found.

The sections from this case, both those from the operative specimen and those from the lesion found at autopsy were similar. In general, the microscopic picture was so much like that described by us in the case of Meyer-Ross⁴ and Ragins, and in the case of Kilgore and Taylor that it will be unnecessary to include a description of the histology of this tumor.

ANALYSIS OF DATA (SEE TABLE II)

Sex and age distribution. The sex of the patients is recorded for all 15 cases. 8 were males and 7 were females. The age of the patient at the time he came under observation is recorded for all 15 cases. At the time of operation the patients were 31, 32, 35, 38, 46, 49, 50, 51, 53, 53, 56, 60, 60, 68, and 71 years of age respectively. Thus the youngest patient was 31 and the oldest 71 years of age. There are 4 patients in the fourth decade, 2 in the fifth, 5 in the sixth, 3 in the seventh, and 1 from the eighth decade.

Location, size and gross characteristics of the primary tumor. The tumor was situated on the right side of the neck in 7 cases and on the left side in 8 cases. In only 4 instances was the site of origin defined more specifically: in 2 of these the tumor appeared to have arisen in the left lower parathyroid, in 1 instance in the left upper parathyroid, and in the last instance in the right upper parathyroid.

In size the tumors ranged from nodules about 3 centimeters in diameter to masses measuring 11 by 11 by 4 centimeters. The majority were rather larger than smaller at the time they came under observation. Apparently the tumor tended to be ovoid or round with surfaces that were somewhat irregularly nodular. In most instances it was surrounded more or less completely by a fibrous capsule of considerable density and several times calcium deposits were noted in the capsule. A distinct tendency for the tumor to be rather firmly and densely adherent to adjacent structures was noted in nearly every instance. The sectioned surface of the tumor varied in color from tannish gray to reddish brown and the consistency of the parenchyma seems to have been much like that of normal liver.

INTERNATIONAL ABSTRACTS OF SURGERY
TABLE II—FIFTEEN CASES ACCEPTED AS PARATHYROID CARCINOMAS

TABLE II—FIFTEEN CASES ACCEPTED AS PARATHYROID CARCINOMAS																
Case Number	Series Number from Table I	Year	Author	Sex	Age	Hyperparathyroidism	Local changes	Regional changes	Location of Tumor	Size of Tumor in cm	Extension, Metastases and Duration					
											Local extension	Lymph Nodes	Lungs	Liver	Bones	Other organs
I	No. 1	1920, 1941	Meyer, Ross, and Rogers	M	60	+	+	+	R—	6x2x4.5	+	+	+	+	+	+
II	No. 2	1920, 1941	Gentile, Scharrer, and Scharrer	M	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
III	No. 3	1920, 1941	Hall and Chaffin	M	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
IV	No. 4	1920, 1941	Toland	M	40	+	+	+	R—	5x2x1	+	+	+	+	+	+
V	No. 5	1920, 1941	Ross and Landover	F	40	+	+	+	R—	5x2x1	+	+	+	+	+	+
VI	No. 6	1920, 1941	De Quervain	M	60	+	+	+	R—	5x2x1	+	+	+	+	+	+
VII	No. 7	1920, 1941	Petersen	M	60	+	+	+	R—	5x2x1	+	+	+	+	+	+
VIII	No. 8	1920, 1941	Bergstrom and Sension	M	60	+	+	+	R—	5x2x1	+	+	+	+	+	+
IX	No. 9	1920, 1941	McQuillan	F	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
X	No. 10	1920, 1941	Price and Mowbray	F	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
XI	No. 11	1920, 1941	Armstrong	M	40	+	+	+	R—	5x2x1	+	+	+	+	+	+
XII	No. 12	1920, 1941	Monteale	F	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
XIII	No. 13	1920, 1941	Kilgus and T. ylor	F	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
XIV	No. 14	1920, 1941	Ober and Maclean	M	50	+	+	+	R—	5x2x1	+	+	+	+	+	+
XV	No. 15	1920, 1941	Young and Emerson	F	50	+	+	+	R—	5x2x1	+	+	+	+	+	+

Recognized duration and growth tendencies of the primary cervical tumor. In all but 3 cases (VIII, XIV, XV) of this series of 15 a cervical tumor had been known to exist by the patient or was discovered by the physician on physical examination. The tumor was discovered by the physician in 2 cases (I, VII) and in another case (II) the cervical swelling appeared just prior to the time the physician was consulted. In 2 cases (VI, XI) a physical swelling had been noted in the neck for about 3 and 4 months, respectively. In the remaining 7 cases (XII, IX, III, IV, X, XIII, V) the patient had known of the presence of a cervical tumor for a considerable time prior to presenting himself for physical examination—1, 5, 5, 8, 8, 10 and 35 years respectively. In all but 3 (IX, XIII) of these 7 cases, growth of the tumor was observed in the months just preceding the operation. The recent enlargement was described as gradual or slow in 3 cases (III, XII) and as rapid in 3 cases (IV, V, X).

Invasive recurrent and metastatic tendencies. In 13 cases the primary tumor showed a tendency to invade locally and was more or less firmly adherent

to adjacent structures (I, II, III, IV, VI, VII, IX, X, XI, XII, XIII, XIV, XV). In 8 cases there was a postoperative recurrence of the tumor at the original site (II, III, VI, VII, IX, X, XIV, XV). In 3 cases the tumor extended into the mediastinum (V, IX) and in one case it spread from the neck through the skin over one side of the thorax (V). The regional lymph nodes were involved in 6 cases (I, II, III, V, VI, XIII), pulmonary metastases developed in 6 cases (I, III, IV, V, VI, X) in the liver in 2 cases (V, VII) and in the kidney bones in 1 case (III). X rays suggested metastases in the bones in 1 case (III). An autopsy was done in 5 cases (I, III, V, VI, XV).

Histopathology. We have attached considerable importance to the structure of the tumor and only those cases in which the cytology and/or the parenchymal pattern strongly suggested parathyroid origin have been accepted as parathyroid carcinoma. Cells of polyhedral form with definite cell walls and cytoplasmic attributes similar to those of the variety of cells found in normal parathyroids have usually been described. In varying proportions in particular tumors, cells that may

be interpreted as dense vesicular clear dark, and oxyphil types have been noted. In general the cells of these tumors tended to be larger than the cells of normal glandules. Mitotic figures were not constant in some cases they were scarce in others numerous. One or more prominent nucleoli were commonly noted in most of the nuclei. The parenchymal elements tended to be disposed in the form of more or less closely packed cords or nests of cells, and in some instances packed follicles containing colloid were noted.

Rather characteristically the tumor mass was divided by fibrous septa into lobules of irregular size and shape the stroma, apart from the dense connective tissue septa, was usually a delicate fibrillar reticulum, or made up almost completely of capillary vessels. The infrequency of necrosis was probably due to the rich vascularity of the tumor. The invasion of the walls and lumens of the blood and lymph vessels in the capsule and septa of the tumor by tumor cells was repeatedly described. In general the recurrent and metastatic lesions showed the same histopathologic structure as the primary tumor.

Endocrine effects. In 7 cases hypercalcemia and hypophosphatemia were noted and in these same cases decalcification of the skeleton was present (I, II, VII, VIII, XIII, XIV, XV). In 2 cases renal calculi were observed (I, XIII). In more than half of the cases such symptoms as asthenia, loss of weight, polyuria, and body pains were described. The surgical removal of the tumor in the cases presenting endocrine symptoms regularly corrected the hypercalcemia, relieved the patient's general symptoms, and permitted recalcification of the bones. All of the symptoms due to hyperparathyroidism returned with the growth of a recurrent tumor and disappeared again following the extirpation of the secondary growth. It is important to note that the metastatic tissue retained the same ability to influence the metabolism of calcium as was possessed by the primary tumor.

Postoperative course. Troublesome postoperative tetany was not observed following the removal of any of these carcinomas.

In this series of 15 cases there was 1 immediate postoperative death (case VI) this patient was operated on in 1909 and died of pneumonia. In 3 cases (VIII, XI, XII) the postoperative record was too brief a period to have significance. Two patients had inoperable recurrent lesions when last seen (Cases IX, V). Three patients (cases V, IV, I) died from visceral metastases 2 and 4 months and 3 years and 8 months, respectively following the operation. In the 5 remaining cases

the results were more encouraging. The patient in case II was living and apparently well 5 years after the first operation and 4 years following the removal of the recurrent tumor. The patient in case III was living 3 years after the first operation and 13½ years following the removal of the recurrent tumor. The patient in Case XIII was living and doing well 1 year postoperatively. The one in case VII was considered cured at the end of 1 year and the patient in case XIV was living and doing well following his recent third operation at which the second recurrent lesion was removed.

DISCUSSION

There can no longer be doubt that carcinomas occasionally arise in the parathyroid glands. Unquestionably this tumor is rare, but it seems probable that more cases will be recognized in the future especially if the parathyroids are examined in all cases in which the primary malignant site is not readily observed. This point deserves particular emphasis in view of the fact that some of the tumors that have been reported were of small size, unless a careful examination of the neck is made in the clinical or postmortem study such primary lesions could be overlooked.

Apparently there is nothing peculiar regarding the age distribution of parathyroid carcinomas the distribution in the reported cases has been about that observed for other epithelial malignancies. The cases are about equally distributed between males and females.

The evidence indicates that the parathyroid carcinoma grows expansively for a considerable time and that there is a marked tendency for it to invade and to become adherent to adjacent structures even at an early period and while the tumor is yet small. General dissemination occurs through both the lymph and blood vessels masses of tumor tissue have been observed in the walls and lumens of the blood and lymph vessels, and metastases have been found most commonly in the lungs and the regional lymph nodes.

Since each of the 15 cases that we have accepted as parathyroid carcinomas was a surgical case it may not be strange that all but 3 presented a clinically recognizable mass in the neck. These 3 cases (VIII, XIV, XV) were explored surgically because of hypercalcemia, hypophosphatemia, and the associated signs of osteitis fibrosa. What is of importance in this connection is the fact that in 7 (47 per cent) of the cases the patient had been aware of a cervical nodule that had been present for an average of 10 years and a mean of 8 years before coming to operation. In 2 other instances a cervical tumor had been noted for a matter of only

a few months. This raises the interesting questions as to whether a benign parathyroid adenoma may become malignant and whether during the early period of its existence a parathyroid carcinoma is a relatively benign lesion. Neither query can be answered finally in the light of available data but there are observations that bear on both interrogations.

In the first place, approximately 95 per cent of the benign adenomas have been associated with skeletal and/or renal changes (Norris, 1947) on the other hand, skeletal and/or renal changes have been observed in only 40 per cent of the cases of parathyroid carcinoma. Perhaps this is about what might be expected for we know that about 1 or 2 per cent of the benign adenomas are nonfunctional and it certainly is not to be expected that all of the malignant tumors of an endocrine tissue would be endocrinologically active.

In the second place the average duration of a parathyroid adenoma before coming to surgery has been from 5 to 7 years (Norris, 1947) and it appears that in the cases of carcinoma a lesion had been present in the neck for at least an equal period, or perhaps longer. Although these observations do not give the answer to the questions just raised they do seem to indicate a likelihood that the benign adenoma will occasionally be found to be a precancerous lesion.

From the biological point of view certainly one of the most interesting features of parathyroid carcinoma has to do with the endocrine potentialities of the tumor. Among the 15 cases we are considering there are 7 in which endocrine effects, quite similar to those produced by benign adenomas of the glandules, were prominent in the clinical picture. In all of these there was clinical improvement following the removal of the tumor in 4 instances the clinical and metabolic betterment was halted with the development of a recurrent tumor and in 3 of these clinical improvement followed the excision of the recurrent lesion. There can be no doubt but that certain parathyroid carcinomas are functional endocrine tumors, the problem of the recognition of this tumor would be greatly simplified if we could be sure that all parathyroid cancers produced an active hormone. However the evidence is to the contrary 8 cases have been reported in which no skeletal alterations were observed and in at least 1 of these (III) there was no alteration of the blood calcium and phosphorus levels. Meyer and Ragins state "Although a number of cases have been reported, the diagnosis of carcinoma of the parathyroid gland is questionable in view of the fact that the blood

chemistry and x-ray examinations in these cases have been incomplete or failed to show the characteristic changes." If all parathyroid carcinomas are to be recognized we are of the opinion that the requirements exacted by these authors are too narrow for there seem to be well proved cases in which no evidence of endocrine activity appeared. The location and structure of the tumor are also features that must be useful criteria.

This brings us to consider these features. Although it is possible for a parathyroid tumor to develop from a glandule included in the substance of the thyroid gland the majority of this type of tumors will certainly be found outside the thyroid, but closely adjacent to it. Indeed the possibility of parathyroid origin must be kept in mind when any epithelial tumor located in the neighborhood of the thyroid is found probably the greatest difficulty will always have to do with the differentiation of tumors of thyroid and parathyroid origin. Many times this differentiation may be difficult and will depend ultimately upon the combined features of the case and particularly upon structural details.

Probably the best descriptions of the microscopic structure of a parathyroid carcinoma are those given by Gentile, Skinner and Ashburn and by Hall and Chaffin. These have been quoted in full.

Until more records of equal quality have appeared in the literature we can do no better than to employ these accounts as a yard stick by which to measure other cases. The descriptions included in these reports together with our observations on the new material reported in this paper constitute the most complete and detailed observations that have thus far been made. Possibly in the future the routine use of glycogen stains and other methods applied to all confusable lesions may be of assistance in the differential diagnosis.

In 1944 Alexander Kepler Pemberton, and Broders reported "fourteen cases of hyperparathyroidism due to formation of a tumor in the parathyroid glands" that had been observed at the Mayo Clinic. In all but 1 of their group of 14 cases a diagnosis of parathyroid carcinoma was made (Table I Series No. 15, 20, 38, 39, 30, 31, 32, 33, 34, 35, 36, 37, 38). As can be seen from Table I these 13 cases have not seemed acceptable examples of parathyroid cancer for reasons about to be enunciated in our judgment all of these cases are better interpreted as benign parathyroid adenomas.

In the first place, these authors based their diagnosis of malignancy entirely upon variability in the size of the nuclei and nuclear hyperchrom-

atism the cancerous state was recognized wholly from morphological features of the individual cells. In our opinion this criterion of malignancy alone is not adequate, especially in the case of parathyroid tumors, because varying degrees of nuclear hyperchromatism are commonly observed in the cells of normal glands and are often seen in the cells of benign adenomas (Fig 16). Wide variations in the size of nuclei including the presence of giant nuclei, have been observed in the present quarter of the reported adenomas.

In the second place these authors state 'In no case in the series under study did metastases or local recurrence occur'. Since the tumors in their series were removed at different times during the past 17 years, it would be only reasonable to expect a percentage of recurrences, metastases, and fatalities if the lesions were frank cancers, as is usual in other forms of malignant disease. Moreover, in their article one encounters descriptive statements regarding the surgical management of the tumor such as the following 'It was readily removed with its capsule. and "Removal was readily accomplished. Similar descriptions have been made frequently by many other surgeons in describing the removal of parathyroid adenomas. On the other hand, as is shown by the 15 cases of the present series local invasion, metastases, and recurrence are common, and the surgeon often encountered difficulties because of the adherent state of the tumor or its invasion of adjacent structures.

In the third place, if 92.8 per cent of the parathyroid tumors in one limited series (Alexander *et al*) are malignant, and only a maximum of about 3 per cent of all the parathyroid tumors reported in the world's literature are cancers, the difference is too great to be readily explained. Castleman and Cope took the same position regarding these cases reported from the Mayo Clinic, as that taken by the present essayist.

So much space should not be allotted to this part of the discussion if fundamental and practical problems were not involved. During the past 20 years the clinical picture of hyperparathyroidism has become well defined and magnificent surgical results have been obtained by the simple enucleation of benign adenomas. If now without the best of reasons, we were to practice wide excision, as for other malignant disease, it is doubtful if the effects would justify the altered procedure. Certainly benign parathyroid adenomas far outnumber the instances of parathyroid cancer and with such information as we now possess it seems important to distinguish clearly between the two forms of neoplasia.

Characteristically the benign adenoma is a soft, reddish brown tumor that is nonadherent and relatively easily enucleable at times it may have grown expansively around the adjacent current laryngeal nerve or some other small adjacent structure but this is different from the adhesion of invasion. Characteristically the parathyroid carcinoma is a relatively firm mass of gray tan color (the brown tones are less conspicuous than in the benign adenoma) and it is likely to be found densely and closely adherent to adjacent structures, from which it may be dissected only with difficulty. The cleavage planes tend to be obliterated by the invasive cancer. Because of these differences in the gross pathology the operating surgeon will often be enabled to make the correct diagnosis at the operating table.

It is necessary to return again to the problems of the growth tendencies and of the microscopic structural constitution of the benign and malignant lesions of the parathyroids. We have agreed that the evidence supports the thesis that a small percentage of parathyroid adenomas may become malignant. Our Case XIV is an instance in point in this case the histology of the original tumor was rather similar to that of a benign adenoma while in the recurrent lesion the microscopic picture had been altered the cells were larger and macro-nuclei and hyperchromatic nuclei were much in evidence.

Almost certainly the original tumor which was removed from Case XIV was a cancer although the microscopic pattern was not altered enough to make possible its certain recognition. Therefore we agree with the group at the Mayo Clinic who contend for the importance of macronuclei and hyperchromatic forms as features helpful in the recognition of malignancy. We do not, however agree that these features alone are sufficient to establish a diagnosis of such great importance. Such other attributes as the size of the cells, the presence or absence of abnormal nucleoli, the general architecture of the tumor and the gross pathological features referred to previously are of greater significance. All of these features must be taken into account in making a diagnosis of parathyroid malignancy.

The term malignant adenoma should be dropped in parathyroid pathology. At best it is a confusing and noncommittal term. Either a parathyroid tumor is benign in which case it should be called an adenoma, or it is malignant and should be called a carcinoma.

Finally it should be pointed out that x ray therapy appears to be ineffectual in the treatment of parathyroid carcinomas. The only effectual

NORRIS CARCINOMA OF THE PARATHYROID GLANDS

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SURGERY OF THE HEAD AND NECK

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Present State of the Intracapsular Cataract Operation
Arnold Knapp. *Arch Ophth.*, Chic., 1947

The author discusses the present status of the intracapsular cataract operation. Many interesting and valuable features are presented. It is pointed out that the thickest part of the capsule is in a region 3 mm. distant from the anterior pole. The thinnest part is at the exact center. The more elastic the capsule the more difficult it is for it to rupture. Following iridocyclitis the capsule thickens so that it can be more readily grasped and intra-capsular extraction performed.

The consistency of the cataract and the tensesness of the capsule also play important roles in extraction. The tensesness is greatest in swollen cataract and in hard cataract in which the nucleus lies directly under the capsule.

The primary step is subluxation of the lens by rupture of the suspensory ligament. The readiness of rupture of the zonule is proportional to the age of the patient. Generally speaking the older the patient, the easier the subluxation. In patients under 45 years of age intracapsular extraction is not easily accomplished. Because the lens can be dislodged more easily tangentially than when drawn forward side to side movements of the lens are useful in attempting subluxation with forceps.

Sclerotic lenses and soft, mature or nearly mature cortical cataracts are easiest to extract. Hard large nuclear and hypermature cataracts are less suitable for extraction and intumescent cataracts are least favorable.

Subluxation may be effected by forceps by exerting pressure on the eyeball causing the head of the lens to present or to somersault, or by suction according to Smith more reliance should be placed on pressure with the lens hook and less on traction with the forceps.

When suction is used the capsule usually ruptures if the vacuum is too great, or the apparatus slips from the cataract if the vacuum is too slight.

Accessory steps are important. They include subconjunctival injection close to the eyeball to anesthetize the ciliary ganglion, incision of the orbicularis muscle by submuscular injection of the eyelids, blocking of the seventh nerve at the stylomastoid foramen or by deep injection anterior to the condylar process, superior rectus suture incision, buttonhole incision or iridotomy, and corneal sutures.

Knapp concludes that the visual results of the intracapsular method are excellent and even better than those obtained by the extracapsular method of extraction. The chief advantages of the intracapsular procedure are the operability of the intracapsular procedure and the freedom from postoperative reaction. Although the intracapsular extraction is more difficult to perform it has been simplified and made easier by better anesthesia and by the use of sutures. Loss of vitreous is the chief danger rupture of the

capsule may present difficulties complications are difficult to deal with. Displacement of the zonulocapsular barrier which occurs in this procedure does not produce any deterioration of the eye.

JOSHUA ZUCKERMAN M D

Ocular Tuberculosis. Retinitis of Jensen (A proposed tuberculous ocular. La réinite de Jensen) G Renard. *Preser med.*, 1947 No. 33 376

Of the 4 cases of retinitis of Jensen all were seronegative for syphilis and all were roentgenologically negative for tuberculosis. Of the 3 adults one reacted positively to the cuti and tuberculin tests. Oddly enough, this patient had also an old healed lesion of the retina of the left eye in an exact symmetrical position with that in the right eye. The other patient had a strongly presumptive family history for tuberculosis. The 3 remaining patients were children who showed no evidence of tuberculosis elsewhere in the body. One responded to antisyphilitic medication (sulfarsenol) in all these patients the exudative retinal phenomena regressed leaving pigmented patches permanent. Sclerotic nodules however remained in the visual fields corresponding to the healed lesions.

The ophthalmologist sees the incipience of disease but is handicapped by the obscurity of etiology. Retinal manifestations seldom develop in the presence of active tuberculous lesions elsewhere in the body and the retina tends to react with an identical form of defense to different aggressors. Only a detailed and exhaustive consideration of clinical types and concomitant etiologic factors will permit any assurance as to the relation which exists between the lesions observed and its tuberculous origin.

Six colored reproductions depict the characteristics and progress of the lesions here cited.

JOHN W BRENNAN M D

A Case of Recurrent Aphthous Urethritis with Associated Ulcus Vulvae Acutum (Lipschuetz) A Rugg-Gunn. *Brit J Ophth* 1947 31 395

The author describes a case of recurrent aphthous urethritis with associated ulcer vulvae acutum (Lipschuetz).

This rare and recalcitrant condition is recognized as a distinct clinical entity. The symptoms of which fall into three main groups (1) periodically recurring urethritis (2) skin eruptions of various types and (3) aphthous ulcers. This type of urethritis occurs in young adults of both sexes between 20 and 30 years of age and evolves by means of relapses over a period of years. Eye symptoms appear to develop rather late in the condition but progressive deterioration and blindness usually result.

In this case which was observed over a period of 28 months dermatological symptoms were absent but the ulcer vulvae acutum of Lipschuetz was present. The patient became pregnant and went on to term. Rigo occurred on several occasions. The disease is attributed to a virus infection.

JOSHUA ZUCKERMAN M D

EAR

Total Ear Reconstruction. Preliminary Report.
Gustave Aufrecht. *Plast Reconstr Surg* 1947 3
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The author presents a procedure based upon the existing methods for the reconstruction of a new ear. It is important to work with exactness and to build a new ear as nearly a match to the normal ear of the patient as possible. Special consideration is given to the stability, size, contour and protrusion of the ear, the depth and circumference of the concha, and other details.

A model ear of acrylic is prepared in every case. Photographs and mouldages are first made of the normal and rudimentary ears. Photographs include each profile, and front and back views. A mirror image of the mouldage of the normal ear is then made of clay or plastofin. From this the acrylic replica is prepared. It is impossible to make an exact duplicate of the normal ear by plastic surgery because of the detailed architecture of the normal ear. Therefore, we must be satisfied with a fair simulation.

In the author's opinion, the deep spacious concha is one of the most important features in creating a normal looking ear and, even if it is impossible to duplicate the delicate contour of the normal ear with the proper depth of the concha the average observer can not greatly notice the lack of finer contours in the reconstructed ear.

Instead of a shell for reconstructive purposes, the pinna is considered as a massive, semicircular body which provides a broad base and assures stability. In the center is a hole, which is the concha. The base of the concha should not contain cartilage and this enhances the depth and aids in the stability of the new ear. The thickness of the cartilage block, which is at a right angle to the skull, varies according to the protrusion of the ear.

In order to provide such a cartilage block, the author has employed two different procedures. One is to prepare a mold in the form of an acrylic case made in accordance with the revision of the mirror model of the normal ear. In making this, allowance must be made for the thickness of the skin in preparing the mold. The inner surface of the case represents

the negative form of the ear cartilage. Many perforations are made in the wall of the mold to allow for adequate blood supply. Sufficient rib cartilage cut up in small chips and thin platelets is put into the case and the cover is secured over it. The entire thing is buried under the skin of the chest and left buried for at least 6 months and kept necessary.

In the other procedure two or three rib cartilages from several of the ribs are pieced together and the broad surfaces are planed down to fit each other. They are tied together with stainless steel wire or silk and transplanted under the skin of the chest for a period of at least 4 months, during which time a fairly firm fibrous capsule develops about it. With either method the following steps are generally the same.

A postauricular flap is prepared and one must be sure to have a larger flap than is thought necessary as a large amount of skin is required to cover the surface of an ear. In spite of a large flap, some additional skin often has to be provided for the lining of the concha, for the helix and the cranial surface of the ear.

The large skin-scalp flap is prepared with a crescent shaped incision and the skin is elevated to a carefully established line, corresponding with the anterior edge of the ear. The flap should be delayed once and may have to be raised in two sections.

If a rudimentary ear is present it should not be discarded but saved so that it can be utilized later.

After the blood supply of the flap is assured, the molded cartilage ear or cartilage block is transplanted under it and accuracy at this point cannot be over emphasized. As much care should be taken as possible to make it correspond with the normal ear, although unfortunately a marked facial asymmetry and other congenital defects may make it difficult. The cartilaginous ear is carefully anchored in its proper location with sutures and the hole representing the concha has to be carved out from the cartilage, if not already prepared. This will allow the skin flap to follow the depths of the concha and will also allow the rudimentary ear cartilage bundle to remain in place temporarily. The blood supply of the flap is carefully guarded and a Thiersch graft is used to cover the skin flap defect temporarily.

In about 4 to 6 weeks the concha is prepared and with an incision, according to the configuration of the rudimentary ear its cartilaginous elements are removed and the skin covering is inverted to form the lining of the new concha. The dimensions of the concha must be exaggerated to allow for the thickness of the skin, scar formation, and contracture and usually additional skin grafting is necessary. Pressure over the skin graft is employed by packing tape and the first dressing is carried out after 12 or 14 days and the concha repacked with gauze for an additional few weeks to counteract any tendency to contracture.

Four to 6 weeks later the cranial surface of the ear is prepared. The cranial surface is now carved so



Fig. 2. Mouldages of normal and rudimentary ears. In the center acrylic mirror model of normal ear.

SURGERY OF THE HEAD AND NECK

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According to the acrylic ear but it should not be deep lest the stability of the new ear be jeopardized. The denuded cranial surface of the ear and the skin defect on the mastoid area are covered with a one-piece graft covering the scalp is excised and the skin edges approximated. After the back of the ear is lined, the ear lobe is attached to the new pinna. If the ear lobe is narrower than that of the normal side, it can be enlarged by unfolding a flap from the posterior surface of the lobe. The defect is lined by the end of the skin tube used for the helix.

Part of the new pinna is usually covered with hairy scalp and the hair can be removed either by electrolysis or surgical resection of the follicles. Now only the attachment of the new helix remains. A clavicular skin tube has been prepared and step by step moved up to the ear. These are then attached in the proper position.

There are many small details and anesthetic requirements in reconstructive surgery which the surgeon must solve according to their presentation.

WILLIAM A. ARNOOD M.D.

Deafness Tinnitus Vertigo and Neuralgia of the J Goodfriend Arch. Otol., Chic. 1947 46 1

Deafness tinnitus vertigo and neuralgia of the lateral facial region are present to some degree in 10 per cent of the population. Many of these are caused by disturbances of joint relationships in the temporomandibular joint. This articular pathology is caused by malposition of the condyle in the relation of the mandible and its condyle is erosion of the articular bone surfaces fibrocartilagenous articular cartilage and degeneration of the mandibular joint and the common wall between the ear and outer ear canal. This dividing wall consists of connective tissue, cartilage and bone which is intimately related to joint and ear structures and lodges and transmits important nerves arteries veins, membranes ligaments and muscles. Over closed traumatic, or maloccluded articulations of the natural or artificial teeth are at fault. Treatment consists of establishing normal joint relationships by replacement rehabilitation or regulation of the teeth.

Three case histories are reported. In cases 1 and 2 patients suffering from severe attacks of vertigo were markedly improved by correcting overclosure of the dental bite and in case 3 the patient was relieved of "chronic tinnitus" in the same manner. Chronic tinnitus is not curable by treatment of the dental bite but often is made more bearable. In cases of progressive deafness hearing cannot be improved but its progress can be slowed. Early deafness, if caused by abnormalities of the dental bite can be cured by proper dental treatment.

JOHN R. LINDSEY M.D.

Rupture of the Tympanic Membrane of Blast Origin F Boyce Korkis J Lar Otol Lond, 1947 61 367

This is a review of 167 cases of acoustic trauma of which 123 or 73.6 per cent, were unilateral and 44 or 26.3 per cent, were bilateral with a total of 111 ruptured drums 57 in the right and 66 in the left ear in the unilateral cases. Cases examined within 1 week comprised 58 per cent in the second week 21 per cent and after a fortnight 21 per cent. The cases considered all presented normal hearing prior to exposure.

High explosives as shells mines and aerial bombs were the most frequent causes of the blast wave. The high incidence of bilateral rupture was caused by booby traps. Explosion in a confined area is more liable to cause bilateral rupture. Unilateral rupture is commonly brought about by a blast wave on the same side as the lesion. A closed or open mouth and the eustachian tube had little influence on the mechanism of rupture but the important factor was the relation of the axis of the external canal to the source of the blast wave. As ear protectors were used by only 2 patients in the series and they also suffered unilateral rupture such protectors are not considered in this work.

The first otological symptom is one of deafness and tinnitus and very infrequently pain during the moment of rupture. Jones-Phillips analyzed 200 cases in the First World War and found the symptoms in order of frequency to be as follows deafness, tinnitus vertigo pain and bleeding. These differed from those of the present series in that headache took the place of pain. Otitis media followed in 47.9 per cent of the cases as compared to 56 per cent as reported by Craig 23 per cent reported by Collins and 34.6 per cent reported by Lundman. Interference such as the applying of drops or syringing increased the incidence of infection. The majority of cases of otitis media occurred within 4 days after injury a surprising number within 24 hours and 1 case as late as after 6 months. Among the predisposing factors are acute nasopharyngeal infection late administration of ear drops syringing or accidental entry of water into the ear and forcible nose blowing. Hospitalization is advocated.

The average time for healing in the cases complicated by otitis media was 38 days and in those without infection 20.4 days. The average total duration of otorrhea was 21.5 days. The shortest time required for healing in the infected group was 15 days and the longest 85 days while in the uninfected series these time periods were 9 and 69 days respectively. In both groups the commonest period of healing was during the third week and in the majority of cases between the third and fifth weeks. Small perforations infected or uninfected healed faster than the medium and large perforations. The most common shapes of perforations are the reniform oval and round varieties always involving the pars tensa (never the pars flaccida) and usually its lower half. In typical uninfected perforation the

membrane appears to be punched out with a clean cut edge and it is very seldom everted. During the period of healing the edges of the perforation become red and thick, and concentric rings of tissue alter its size and shape until the tympanic membrane appears to be normal or the scar becomes permanently visible with retraction.

Functional examination of the ear by whisper and conversational voice tests, tuning forks, and the audiometer showed a minor degree of deafness in 37 per cent, a moderate degree in 48 per cent and a severe degree in 15 per cent. The author found the Rinne and Weber tests fallacious in determining the type of deafness. Recovery of hearing for low tones appears to precede that for high tones and in mixed deafness a high tone loss persists. Illustrative audiograms are given.

A. B. VICKARIO, M.D.

Closure of Perforations of the Tympanic Membrane. Albert M. Dunlap and Harold F. Schuknecht. *Laryngoscope*, 947 57 479.

The authors report a series of cases of closure of the tympanic membrane by the use of trichloroacetic acid cautery. This method is not new having first been tried by Okuniff in 1895, and again used in 1917 by Dunlap reporting from China.

The authors also mention other methods that have been tried to close perforations of the ear drum, including small skin grafts, egg skin, wax, paraffin oil soaked into a cotton ball, cadaver stapes, Cargile's membrane and gold dental cylinders. The more recent work on artificial membranes has been reported by Niskell and Stefmann, both of whom use cellophane.

Some definite benefits can be derived from permanent closure of drum defects: (1) there is often relief from repeated ear infections in those previously subject to them; (2) in some cases there is an increase in auditory acuity and in interpretation of the source of sound; (3) closure of a drum defect is an aid to applicants to specialized military and civilian training schools, who previously could not meet the requirements; (4) occasionally there is relief of troublesome tinnitus; (5) after a drum has been repaired, patients can return to aquatic sports without fear of otitis media.

The authors' method is not a new one. It consists of repeated applications of a small amount of saturated solution of trichloroacetic acid to the margin of a drum perforation. It is necessary to apply a local anesthetic to the edge of the drum first, and a good anesthetic agent consists of equal amounts of menthol, phenol, and cocaine. After application of the anesthetic the margins are wiped dry so that the acid will not be diluted and run on to the adjacent drum membrane.

A small copper or silver wire bent into a loop at one end for a handle is dipped into the acid and carefully applied to the entire margin. Where the acid touches the drum, a white eschar appears and one can see how completely the margin has been treated. Applications are made at weekly intervals until a

good granulating margin has been obtained. This may require weeks or months. Unlimited patients must be had on the part of both patient and doctor.

The use of two or three drops of saturated solution of urea once or twice a day will incite an inflammatory response and may aid in the closure.

Formation of an exudate along the margin is evidence that activity is present. Any dried exudates are removed once or twice a month. If necessary Closure is slow until the entire margin is active and inactive segments of the margin fail to show a line when touched with a cotton tipped applicator. When the entire margin becomes active, cauterizations should be less frequent, but the urea drops should be continued.

With this procedure a period of from 6 months to 1 year is required for closure, depending upon: (1) size of the perforation, (2) occurrence of intervening attacks of otitis media, (3) character of drum response, (4) age of the patient and (5) the skill and perseverance of the operator. The results are better in the younger patient, although patients over 50 years of age have been successfully treated.

Contraindications to attempting closure of a drum perforation are: (1) any form of mastoid disease; (2) the presence or suspicion of cholesteatoma of the middle ear; (3) destruction of the ossicular chain in some cases; (4) continuously discharging ear; (5) complete loss of pars tensa; (6) large marginal perforations; (7) obstruction of the eustachian tube.

The authors discuss the histopathology of perforations of the ear drum. They state that repair of a drum perforation stops when more hardy, rapidly growing stratified squamous epithelium of the external surface of the drum grows over the edge of the perforation and meets the pseudostratified columnar or cuboidal mucous membrane of the middle ear. Destruction of the perforation margin with acid removes this epithelial barrier and incites, by tissue destruction, an inflammatory healing response in the drum margin. Proliferation in the middle layer of the drum is responsible for the laying down of new tissue, and regeneration of the drum begins. Frequently after the drum has healed it is difficult to tell the new part of the drum from the old.

The authors show several photomicrographs of the histopathology of a perforation of the ear drum and also in diaphragmatic form, show the type of perforations that they have successfully closed. A few representative case histories are given.

WILLIAM A. ANDERSON, M.D.

Tests for Labyrinth Function following Streptomycin Therapy. Aram Glorig and Edmund Prince Fowler. *J. Am. Otol. Rhinol.*, 947 56 379.

Vestibular and audiometric tests were performed in 38 cases of pulmonary tuberculosis before, during, and after streptomycin treatment. Of 23 patients who had had more than 3 months of streptomycin therapy all but 1 patient maintained a normal audiogram. Almost all patients had vestibular disturbances. Slight nystagmus on lateral gaze and

blurred vision while reading frequently occurs before changes in vestibular function are noted. In most cases vertigo occurs in from the twentieth to twenty fifth day of treatment. After turning the head or body the patient has the sensation of continuing to turn later there is vertigo only on sudden movement. The caloric test used was a slight modification of the method of Fitzgerald Cawthorne and Hallpike. By carefully controlling water temperature it was noted that responses to water at 30° C and 44° C were approximately equal.

In 35 cases the nystagmus times were first shortened by 30 seconds or more on the twentieth to the twenty fifth day of treatment. In 30 cases the patient gave no response after periods of time varying from 30 to 67 days. All persons whose gait could be tested walked with a broad base and some ataxia, which began in from the third to fourth week. Compensation was gradual and at 4 months incapacity was not perceptible if vision was unobstructed and the walking surface smooth. Difficulty was experienced when walking on a rough surface or in dark, unfamiliar surroundings. Rotation produced no reaction and galvanic tests showed decreased response in the patients tested. There has been no recovery up to 4 months subsequent to the first negative caloric response. Eight patients in another series have shown no recovery after 1 year. Tilt table reactions have delayed jerky and inadequate adjustment reactions suggestive of a peripheral lesion. The lesion in these cases is probably in the labyrinth however thus far no supportive micropathology has been found in the specimens studied. Sound location was normal in the cases studied which refutes the idea that this function resides in the vestibular apparatus.

NOSE AND SINUSES

Penicillin Therapy in Chronic Suppurative Sinusitis. A Report of 23 Cases. Harold Boyd, Laryngoscope 1947 57 400.

The author presents the results of his experience with penicillin to the treatment of 23 patients with chronic suppurative disease of one or more paranasal sinuses. Both the subjective and the objective findings indicate that chronic suppurative sinusitis does improve with penicillin therapy. Numerous reports from the literature (from late in 1942) on the treatment of sinusitis with penicillin are reviewed. The different procedures in which penicillin was used are discussed and some reports by other authors are briefly presented in which it is recognized that acute disease of the ears, nose and throat responds readily to penicillin however only a few favorable reports of its use in the treatment of chronic sinus disease have appeared. The author states that penicillin therapy preoperatively and postoperatively in surgery for chronic sinus disease has given excellent results. The cases reported include all patients with chronic suppurative sinusitis who were admitted to an Army

General Hospital in the United States from October 1944 to February 1946. All cases of acute sinusitis or subacute sinusitis were omitted. The majority of the patients had been given previous treatment surgery in some cases and therefore the possibility of improvement by conservative treatment seemed questionable.

In general, all cases were dealt with as follows: A careful history was taken and a clinical examination of the ears, nose and throat was carried out and all findings recorded. Roentgenograms were taken and cultures made of the pus from the sinuses, although it was impossible to make cultures of anaerobic organisms.

The patients were seen in the ear, nose and throat clinic every 2 days and, when necessary, the nasal mucosa was shrunk down by topical application of a 1 per cent cocaine solution and 35 per cent neosynephrine. Free pus was removed by gentle suction. The affected maxillary sinuses were then lavaged with normal saline solution until the return flow was clear. A needle was introduced into the antrum through the inferior meatus and with the needle still in place penicillin solution containing 250 units per cubic centimeter was instilled until there was a copious return flow from the nose. Careful notes of improvement as the result of treatment were taken at each visit, as well as the amount and character of the pus removed. At the same time the patient was given intramuscular injections of penicillin 30,000 units every 4 hours for six doses daily. As a rule, sinus irrigations were discontinued after the second negative lavage but systemic penicillin was continued for a longer period, usually for 14 days. If the nasal mucosa did not resume a normal appearance penicillin was continued longer. At the time when all penicillin was discontinued, sterile saline was instilled into the sinus and after 5 minutes a sample was withdrawn and sent to the laboratory for final culture studies.

Not only initial x-ray examinations were taken but, in addition, follow up x-ray examinations were made at intervals irregularly at first but later as soon as the sinuses were clinically clear and at least once again before the patient was discharged. When the patient was clinically symptom free he was usually sent on a 30 day convalescent furlough and upon his return a careful interim history was obtained and a further clinical study carried out and recorded. Additional sinus cultures were also taken at that time.

Although intensive local therapy other than that mentioned above was not used in the cases reported sound surgical principles of drainage were not neglected. In one case a submucous resection had to be done and in another case a nasal polyp was removed. Infraction of the middle turbinate was done routinely in all cases with questionable drainage due to edema and swelling in the middle meatus. The average age of the patients treated was 27½ years. Each patient was incapacitated for further useful service in the Army because of chronic sinus.

itis. The duration of symptoms varied from 8 weeks to approximately 10 years. The author presents in some detail the type of sinusitis shown in each of the 22 cases and the previous treatment which they had received. Included is a table of the types of sinusitis treated. Four of the 22 patients showed some allergic manifestations and the author states that in these patients there was no return to normal after clearing of the infection because of the allergic condition. The organisms isolated from the different cases are mentioned.

Nineteen of the 22 patients stated that they felt well at the end of the follow-up period, which speaks well for the treatment that they received. Three patients were not entirely well and one of these had a definite nasal allergy and his only complaint was occasional sneezing. Another patient felt improved but complained of mild, persistent headache. This patient was discharged from the Army for other reasons before a sufficient period of observation. The third unimproved patient had persistent headaches and objectively he had profound improvement in his sinusitis. His headaches were thought to have a neuropsychiatric basis.

Further analysis of the results showed that in 21 cases suppuration from the nose and sinuses cleared up entirely as far as could be determined clinically in the remaining case there was slight crusting over an atrophic middle turbinate, a result of previous surgery.

In 5 patients nasal stuffiness persisted to some degree. In 4 of these the condition was one of proven or suspected allergy. The fifth patient was entirely free of symptoms except for periodical nasal stuffiness.

The appearance of the nasal mucosa returned to within normal limits in all but 5 patients. Four of these had an allergic rhinitis, and 1 had a mild atrophy of the middle turbinate.

In general, the improvement shown in x-rays of the sinuses was considerably less than one would expect from the favorable clinical results. However, the clinical improvement was usually accompanied by corresponding improvement in transillumination, regardless of the x-ray appearance.

WILLIAM A. ARROGG, M.D.

Rubber Catheter used to Maintain the Patency of the Ostium to Dacryocystorhinostomy; a Preliminary Report. Joseph L. Goldman. *Arch. Otolaryng. Chlc.*, 1947 46 58.

The author gives a brief résumé of the operative treatment of chronic dacryocystitis by either the external or intranasal approach. In general, the ophthalmologists have favored the external, while the rhinologists have favored the intranasal procedure with some exceptions such as the modified Toti external operation by Mosher and the intranasal dacryocystorhinostomy of Wiener and Sauer a modification of the West technique.

This is a report of 4 cases in the armed forces in which there was obstruction of the lacrimal system.

In 3 intranasal dacryocystorhinostomy (Wiener-Sauer) was performed and in the fourth one an external operation (Toti Mosher) was done. The intranasal operation in brief, was as follows.

The posterior portion of the lacrimal bone containing the lacrimal sac was localized by passing a Ziegler probe into the sac and through the lacrimal bone into the nose always with traversing of a part of the anterior ethmoid labyrinth. The anterior tip of the middle turbinate was removed and the anterior ethmoid cells exenterated. With a small gouge and ethmoid punch forceps, the lacrimal bone was removed followed by excision of the adjoining thickened wall of the lacrimal sac with a No. 11 Bard Parker blade. A lacrimal syringe needle was inserted into the sac to outline its limits. After the creation of the ostium, a black silk thread was passed through the inferior canaliculus into the nose and the eye end of a straight needle and this lower end of the thread in the nose was sutured to the end of a rubber catheter No. 12 or 14 and then the catheter was pulled into the sac. A strip of adhesive tape on the forehead anchored the upper end of the thread to hold the catheter in position. Bleeding was controlled during the operation and no packing was used. A submucous resection of the septum was done to obtain adequate exposure of the lacrimal area.

In the fourth case, because of the absence of the lacrimal sac, the Toti Mosher technique was employed except that the nasal mucous membrane and the sac were not sutured together but, instead, a No. 10 catheter was inserted into the fundus in the same manner as in the intranasal operation of the aforementioned 3 cases. A preliminary submucous resection, with removal of the anterior tip of the middle turbinate and anterior ethmoid cells, was also done on this patient.

In 2 patients it was necessary to remove the catheter and thread on the seventh day because of a local inflammatory reaction in the canaliculus and adjoining portion of the sac. In the other 2 patients there was no local reaction. 1 received sulfadiazine for 8 days and the other penicillin for 14 days, post-operatively and the catheter and thread were removed on the fourteenth day. It is believed that penicillin should be the drug of choice for this purpose. Merbromin and fluorescein were used to test the patency of the ducts. The patients were observed for the following periods: 2 years and 2 months, 3 months, 4 months, and 5 months. Direct contact was lost with the first 3 patients because of transfer to other installations, but they were advised to write the author for any evidence of closing of the ostium and such information has not been received.

A. B. VINCIGUO, M.D.

Estlander Abbe Operation to Treating Secondary Hardlip Deformities and Defects of the Upper Lip Resulting from Cancer. Varnstedt H. Krasnjian. *Plast. Reconstr. Surg.* 1947 3 307.

The author describes the treatment of secondary defects in cleft palate patients and the principal types

of deformities. These deformities are not apparent at first but as the child grows older they become more conspicuous. Special attention is called to the under development of the upper jaw and the upper lip and the overdevelopment of the lower lip to compensate for the defect of the upper

The general principles of treatment are outlined and it is recommended that the construction of an adequate framework in the form of a dental appliance be carried out to act as a support to the upper lip in addition to the Eastlander Abbe operation. The procedure of this operation is described in detail and the article is illustrated with 30 photographs.

JOHN F. DETM, M D

MOUTH

Temporomandibular Joint Arthritis and Its Treatment by Extirpation of the Disc. Karl Boman
Acta chir scand 1947 95 Supp 118

The most common cause of injury to the temporomandibular joints is malocclusion of the teeth. Direct trauma to the mandible and inflammation in and around the joint will precipitate symptoms in some cases. The common local symptoms are crepitation snapping limitation of motion and pain in the joint. Peripheral symptoms of headache referred pain to various areas of the head and dizziness may occur. The literature is reviewed on the question of the effect of malocclusion on eustachian tube function.

In a survey of healthy adults more than one third were found to have a history of having had snapping mandibular joint. In exceptional cases severe symptoms may persist and treatment is required. The fibrocartilaginous disc of the temporomandibular joint was extirpated in 58 cases. Thirty cases were followed clinically for more than 4 years. Local anesthesia was used in the 20 patients operated upon by the author.

A vertical or angular incision over the joint and extending upward around the anterior border of the auricle has proved satisfactory.

The functional disturbances in the joint noted at the time of surgery were classified as follows: (1) luxation of the condyle of the mandible and disc in front of the articular tubercle on opening movements, (2) luxation of the condyle in front of the disc on opening movements (3) displacement of the disc on pediment to movement in the joint (4) an impingement on movement in the joint for which no cause was ascertained. (The upper joint exists between the disc and temporal articular surface and the lower joint between the disc and articular surface of the condyle.)

Macroscopic changes found in the disc consisted of nodular deformity of the surface, central lateral perforations and yellowish brown discoloration. Microscopically all but a few cases showed degenerative changes (hyaline and fibril degeneration, myxomatous degeneration, calcium deposits)

Extirpation of the entire disc necessitates disconnecting the upper portion of the lateral pterygoid muscle so that forward movement of the condyle is reduced. If further limitation of movement is required in luxation cases the lower part of the lateral pterygoid muscle may also be loosened. Plastic procedures for reducing motion in the joint are unnecessarily complicated procedures. The patients can masticate food usually in a few days after operation however there is usually pain on maximum opening movements for several months. Frequently there is slight crepitation in the joint after operation and sometimes also a slight limitation of motion. On opening of the mouth the jaw tends to deviate to the opposite side. The operation causes limitation of the ability to deviate the jaw to the operative side. Follow up examinations have shown no change in the joint not subjected to operation. Both local and peripheral symptoms of temporomandibular joint arthrosis have been immediately and permanently relieved by removal of the disc.

JOHN R. LINDEAY, M D

Mixed Tumors of the Salivary Gland Type J. E. Ash
Am J Orthodont 1947 33 332

The author believes the majority of the classic studies of mixed tumor of the salivary gland have been made with the preconcived idea that it was just another tumor of the salivary glands predominant of the parotid gland. He believes that much of the confusion concerning the histogenesis has arisen from the attempt to correlate the histogenesis with the embryology of the salivary glands. The modifying word "mixed" was originally used because it was thought that two embryonal layers must be concerned since both epithelial and mesenchymal elements were included. At present although the general opinion is that only one layer, either the dermo or endoderm is involved the term has persisted but now it implies a mixture of histologic rather than embryologic elements.

Any satisfactory argument must be based on definite functions. In selecting cases for this study the author's criteria are that the tumor contain an epithelial element which may range from basaloid to columnar mucin-secreting epithelium (not excluding the squamoid type) with diversified arrangement of solid masses of the basaloid or squamoid type through small, undifferentiated groups and through canaliculi to well organized acini and through mucinous, through gelatinous and myxomatous of chondroid and osteoid material, and even to mature cartilage and bone. Any combination of these epithelial and stromal elements identifies a mixed tumor. On this histologic basis the author has so far found 917 cases in the files of the Army Institute of Pathology and while they are predominantly from salivary glands, they have been found in other and bizarre anatomic situations.

An accompanying table shows that the parotid gland was involved in 503 instances.

Analysis of figures at large medical centers indicates that under ordinary circumstances the tumor is met with only occasionally. It may occur at any age, and several times it has been seen in infancy, although there has been no example of a congenital tumor. It seems to be the general experience that the majority of patients first come under observation when they are between 30 and 40 years of age. If the ordinary criteria of malignancy are strictly adhered to, salivary mixed tumor can be considered one of the benign tumors, although the possibility of recurrence is ever present.

No satisfactory histologic criteria on which to base prognosis have been recognized.

The tentative conclusion if any to be drawn from this analysis is that we must drop the term "salivary gland tumor" and use "mixed tumor" generically as referring to neoplasms that may arise in any organ or tissue containing glandular epithelium which is associated with a stroma sensitive to the "organs" of that epithelium. JOHN F. DIXON, M.D.

Central Myxoma of the Jaw. Kurt H. Thoma and Henry M. Goldman. *Am J Orthodont.*, 1947 33 534.

The purpose of this report is to call attention to a rather uncommon type of tumor found in the jaws, the so-called myxoma. Hitherto this tumor has been regarded as similar to that seen in the long bones which tends to recur and is often malignant. This study based on 21 cases, shows the tumor to be benign and perhaps of odontogenic origin.

Myxoma is a term used to indicate tumors which are composed of loose connective tissue with branched cells widely separated by a viscid, opalescent, mucoid fluid. While such tissue is not found in the adult body it does exist in the umbilical cord this tissue thus stands as the prototype of this tumor. However the myxoma is regarded by most pathologists as a modified form of fibroma in which a mucoid intercellular substance separates an embryonic type of connective tissue so as to resemble in appearance the tissue of the umbilical cord. Thus, a pure myxoma is rarely if ever encountered but a myxomatoid change in a portion or even the whole of some other type of connective tissue tumor is seen relatively frequently. JOHN F. DIXON, M.D.

PHARYNX

Carcinoma of the Tonsil. John H. Walker and Clifford D. Schulz. *Radiology* 1947 49 6.

The occurrence of carcinoma of the tonsils is relatively uncommon. In the present article the authors have reviewed the cases of all patients with carcinoma of the tonsil who had been treated with irradiation at the Collis P. Huntington Memorial Hospital Boston from 1936 to 1941 and at the Massachusetts General Hospital Boston, from 1936 through 1945.

Irradiation therapy was given in 90 cases. Eighty four per cent of the patients were males with a me-

TABLE II.—TUMORS OF THE TONSIL.
OVERALL SURVIVAL

Years survived	No patients with opportunity to survive	No. alive who survive
1	70 ^a	43 (61%)
2	66	36 (54%)
3	56	24 (42%)
4	49	9 (18%)
5	39	6 (15%)
6	5	3 (60%)
7	61	3 (5%)
8	5	1 (20%)

^a Eleven patients did not have opportunity to survive and were not included in this analysis.

dian age of 63 years. This confirmed the common belief that cancer of the tonsils occurs most frequently in males in the seventh decade of life.

Because of the insidious onset, there was a median delay of 3 months before the patients sought medical attention. The most common complaints were sore throat and swelling of the neck. Lymph node metastases were often the first warning to the patient of the disease and this was present in over 60 per cent of the patients when they first consulted a doctor.

The majority of the tumors (87 per cent) were epidermoid carcinomas of varying grades. Tumor classified as grade I did not metastasize early although they were locally recalcitrant to irradiation.

Neck dissection was not employed in this series because of existing metastases, or the fact that patients were poor surgical risks. Both supervoltage and high voltage irradiation were employed. In general, as much radiation is directed into the tumor as can be safely tolerated by the overlying tissues. Detailed numerical formulas are given, and figures pertaining to periods of survival are shown in Table I.

Only 6 patients, or 15 per cent, have survived for 3 years or longer. The prognosis cannot be made on the grade of tumor alone. Patients with higher grade tumors (II and III) lived longer than those with grade I tumors. Lymphoepitheliomas gave the best response of all. As might be suspected, those patients who were free of metastases survived, on the average, considerably longer.

No striking advantage was evident from combined radium and roentgen therapy. When the recurrence did not appear until 1 year after the initial treatment, supplemental treatment appeared to be of definite value. At present it appears that supervoltage more effective than high voltage radiation.

The authors state that in general x-ray treatment alone gives results which are as good as those from any other single procedure or from a combination of several procedures.

ERNEST D. BLOCHMANTAL, M.D.

Massive Atelectasis following Tonsillectomy and Local Anesthesia: Report of a Case. Leroy Sawyer. *Arch. Otolaryng.*, 1947 46 45.

The author searched the literature for reports of massive atelectasis following tonsillectomy and

local anesthesia during the past 40 years and found 1 case recorded by Iglaue in 1857 who also mentioned 1 case each for Goodyear and Middleton. Clerk told the author of another case. In general surgery the incidence of another case has been vari- ously reported as causing from 3 to 70 per cent of all postoperative complications with a 40 per cent mor- tality. Among the predisposing causes favoring atec- tasis are oral sepsis acute or chronic upper respi- ratory infections, shock, and possibly allergy. Workers on the pathology of atelectasis revealed that excessive bronchial secretion plus the postopera- tive obstruction is the frequent pressure distal to the collapse. According to Brunn atelectasis is the ob- struction is the frequent pressure distal to the ob- struction. Cases have been reported in which the ob- struction occurred after a fall from a horse or a bicycle without the fracture of a bone or even a trivial bruise of persistent cough recurrent sore throat, and tonsillitis. On physical examination the throat found to have large hypertrophied tonsils and bi- lateral cervical adenopathy. Other findings were normal except for a slightly increased right hilar shadow on the roentgenogram. Preoperative medi- cation consisted of sodium amylal 3 grains, morphine 1/6 grain and atropine sulfate 1/50 grain. Procaine hydrochloride 1 per cent with epine- phrine 1 to 50,000 was used for local anesthesia. During the operation the bleeding was average in amount, which was readily controlled without liga- ture or stitches. At noon, the patient complained of throat pain for which she was given pantopon, 1/6 grain. There was no coughing or bleeding or further complaint during the day. At bedtime she was given sodium amylal 1 1/2 grains. Nearing midnight she complained of precordial pain and the next morn- ing she had severe pain in the right side of the chest, some coughing, a respiratory rate of 32, a pulse rate of 108, a temperature of 101.4 F, and a moderate leucocytosis in the blood count. Physical examina- tion showed diminution of breath sounds and de- creased tactile fremitus over the right lung with de- creased tactile fremitus and an impaired percussion note. The roentgenogram revealed collapse of the right lung, the heart margin well over to the right. Intercostal spaces narrowed and the right diaphragm markedly elevated. The next morning bronchoscopy was performed under local anesthesia and a bloody mucus plug was aspirated from the right main bron- chus. Immediately after the endoscopy the tempera- ture and the pulse and respiratory rates fell ap- idly and breathing became easier. Twenty four hours later another roentgenogram showed the tem- perature and the heart almost back to its normal posi- tion. The leucocyte count also became normal after a few days. The patient was seen 3 months and 1 year later respectively and the physical findings and roentgenograms gave normal results. The author

commented that the patient was given more than the average preoperative sedation. It seems that after a (Abstractor's comment) rather heavy preoperative medication, especially with the use of the time honored atropine sulfate which tends to dry the bronchial secretions producing viscid and tenacious mucus plugs, the postoperative administration of pantopon should not be encouraged as it diminishes cough reflex thereby favoring the oc- currence of atelectasis.) A. B. VICKERS, M. D.

NECK

Determination of the Relative Activities of Anti- thyroid Compounds in Man Using Radioactive Iodine. Malcolm M. Stanley and E. R. Astwood. *Endocrinology* 1947, 41: 66.

It is difficult to evaluate the potency of antithy- roid compounds according to the response to treat- ment. Furthermore, general clinical experience in- dicates a discrepancy between clinical potency and designed a quantitative experiment on normal hu- man subjects to determine the potency of various compounds in preventing uptake of radioactive steps in iodine accumulation in the thyroid gland. (1) concentration of iodide ion in thyroid tissue which accounts for but a small fraction of iodine present in the normal gland, and which is inhibited by thiocyanate and (2) the synthesis of inorganic iodide into organically bound iodine. The latter step is thought to be inhibited by thiocyanate and similar compounds. Thirty two compounds and similar (12M) dose of 0.1 millicurie of radioiodine weakly alkaline solution. Iodine accumulation in the thyroid gland was measured by a special Geiger Muller tube placed over the isthmus of the thyroid. Four counts of from 20 to 40 seconds were made every 10 to 40 minutes during the first few hours of rapid accumulation then hourly for the rest of the day and finally at the end of 24 hours. The curve representing rate of accumulation was S shaped with the most rapid accumulation in the period from 14 to 4 hours. Except for the initial 14 hour period the curve had the general shape of a parabola and plotted against the square root of the elapsed time formed a straight line. In the test of an antithyroid agent the straight line function for iodine accumu- lation was plotted for 1 or 2 hours after administration of radioiodine then the agent was given and the degree and duration of change of direction of the line was expressed as a score of 0 to 5

- 0 = no effect
- 1 = slight or questionable inhibition
- 2 = definite but incomplete inhibition
- 3 = complete inhibition for 4 hours
- 4 = complete inhibition for more than 4 but less than 24 hours
- 5 = complete inhibition for 24 hours

Compound	Activity for human being	Activity for rat
Thiouracil		
Tetrahydro-6-thiopyrimidine		3
6-Methylthiouracil		
6-Ethylthiouracil		2
6-Cyclopropyl thiouracil		3
6- <i>n</i> -propyl-thiouracil	7.5	1.0
6- <i>n</i> -butylthiouracil	7.1	
Thiobarbital		7
Thiourea		
Thiocarbonyl-thioglycolic acid	3	
2-Mercaptoimidazole		
2-Thiolythiazole	2	4
2-Aminothiazole	1	5
2-Mercapto-2-amino 1,3,4-thiazole		1.5
Bisulfite	0.5	

Although there was considerable variation among subjects in the initial slope of the accumulation curve, the score of inhibition for a given compound was quite constant. There was also a close relation between dose and score. The table is abstracted from the complete table of Stanley and Astwood and lists only the more effective compounds comparing potency by the present test, and by the rat assay. Thiouracil has been given the arbitrary value of 1.

This method of testing based upon a single administration of the antithyroid drug does not indicate the relative potencies when repeatedly administered since cumulative effects might occur especially with longer acting substances such as thiobarbital and thiouracil.

CLAYTON H. THURKES, M.D.

The Use of Propylthiouracil in Hyperthyroidism

Arnold S. Jackson. *South. Surgeon*, 1947 15: 65.

The author reports his experience with 70 cases of toxic goiter treated by propylthiouracil, and refers data from 1,500 cases of other investigators. He states that to his knowledge there have been no deaths due to propylthiouracil among his own cases, only 1 presented a serious reaction to propylthiouracil, namely a leucocyte count of 2,500. The patient was a child of 9 years, who took 75 mg daily for 6 weeks. After a rest period of 2 weeks, iodine therapy propylthiouracil was resumed. However in a personal communication to the author, received February 7, 1947 Bartels stated that of 39 patients, 1 of them had a fever and 5 showed significant blood changes attributable to propylthiouracil.

Although the author's purpose in giving propylthiouracil is to prepare patients for surgery, he has not as yet operated on any children, although he had 4 children under 14 years of age as patients on propylthiouracil. Jackson concludes from his own experience and that of others that propylthiouracil has definitely replaced thiouracil as a much safer drug, but since propylthiouracil does not alter the pathology it is questionable whether it will prove curative in exophthalmic goiter, however he hopes it may prove curative in early mild cases. The greatest value of the drug is in preparation of bad risk cases of hyperthyroidism for thyroidectomy. These include the aged and patients with cardiovascular disease, diabetes, liver damage, or other complications.

The basal metabolic rate returned to normal more rapidly with propylthiouracil than with thiouracil, there was, nevertheless, much variation.

The author's procedure was to give 50 mg. of propylthiouracil on an average of 3 times daily the dose being varied according to the severity of the disease. As soon as the basal metabolic rate reached normal the patients were continued on small maintenance doses. A leucocyte count was made every 3 weeks.

CLAYTON H. THURKES, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS CRANIAL NERVES

The Diagnostic Significance of Ocular Pain in Craniofacial Trauma T M Mokhov *Am Rev Seriet M* 1947 4 400.

The authors point out that the tentorial syndrome of pain in the eyeballs forehead and neck, accompanied by photophobia lacrimation and a marked increase in conjunctival and corneal reflexes has been known for several years. It is presumably due to irritation of the recurrent branch (nerve of Arnold) of the ophthalmic division of the trigeminal nerve. Likewise attention is called to the fact that in previous studies of localized pachymeningitis secondary to splinter injuries of the skull acute ocular pain is prominent on upward downward and lateral gaze.

With these reports in mind 100 wounded patients were examined for the diagnostic significance of ocular pain. At operation localization depth and character of the injury were noted. Acute spontaneous ocular pain followed by lacrimation and photophobia were found to be outstanding complaints in patients with meningeal involvement in the nuchal region. Ocular pain alone was more characteristic with lesions of the middle and anterior fossae. In cases in which injury had occurred in the convex frontal and central cerebrum ocular pain was present only upon movement of the eye balls. If the process became aggravated spontaneous pain made its appearance followed by photophobia and lacrimation in the acute phase. When ocular pain was present on movement of the eye balls it was frequently significant in localizing the lesion because pain occurs upon glancing to the affected side. Likewise spontaneous ocular pain was intensified in most cases upon glancing toward the side of the lesion. There was indication of a bilateral process or involvement of the tentorium if pain was equally acute in glancing in both directions.

Ocular pain either spontaneous or upon movement of eye balls, occurred in wounds with penetration of the dura by bony or metal splinters in depressed skull fractures or in local pyogenic lesions involving the dura. Pain was not observed when the dura scarred evenly when wounds due to metal or bone splinters were in the cerebral substance distant from the meninges or when fistulas had developed from the dura down to a deep cerebral abscess. Five case histories are presented in part to support the author's conclusions. RICHARD C. SCHWENKER, M.D.

Partial Excision of the Motor Cortex in Treatment of Jacksonian Convulsions: Results in 41 Cases. Cobb Plicher W F Meacham and T J Holbrook. *Surgery* 1947 34 653

Although excision of the motor cortex for treatment of focal epilepsy was first done by Horsley in

1886 this procedure has received relatively little attention until the last decade. The author discusses cortical resection in 41 patients who suffered from Jacksonian seizures. All had focal cortical convulsions without any gross cicatrization or space-occupying lesions of the brain. No patient was subjected to surgery unless failure or extreme difficulty of control with anticonvulsant medication had taken place.

The operation was done with the use of local anesthesia. After an osteoplastic flap had been reflected and the dura mater incised, electrical stimulation of the motor cortex with a unipolar electrode was done until the desired area was localized. In several instances the patient's convulsive episode was reproduced. After identification of the involved area, subpial cortical resection was done. In 6 patients (with focal sensory phenomena clinically) that portion of the postcentral gyrus corresponding to the extent of the precentral excision was also taken out.

The brain appeared grossly normal in 24 of the 41 patients. In the others there was arachnoidal thickening with grayish opacity or apparent shrinkage and atrophy of the convolutions. Microscopically the excised tissue was normal in 14 patients in 25 there was a distinct increase in glial elements and in 2 there was found to be an additional fibrosis.

Two phenomena were noted which strengthened the presumption of a hypersensitive cortical focus for this type of convulsive seizure.

1 Less voltage was required to produce a motor response in the area of motor cortex responsible for the focal attacks than was needed to cause a motor response elsewhere.

2 Stimulation of the appropriate cortical point reproduced the patient's seizure whereas stimulation elsewhere in the motor cortex caused only the conventional motor response.

Immediately following operation each patient showed a complete flaccid paralysis of the affected part. Spasticity developed gradually usually in 4 to 8 weeks. Within 8 to 20 days voluntary motor recovery had begun in all instances, and in 4 to 6 weeks perceptible voluntary movements had appeared in all muscle groups.

There were 2 operative deaths. Little or no disability occurred except in 4 patients with moderate (3 patients) or severe (1 patient) hemiparesis. Eight patients were completely relieved of convulsive episodes 12 showed pronounced improvement 8 improved to a lesser degree 8 had no improvement and 3 subsequently died.

The authors conclude that partial excision of the motor cortex in selected cases with focal motor convulsions is a valuable procedure.

C. FREDERICK KITTLE, M.D.

SPINAL CORD AND ITS COVERINGS

Lesion of the Intervertebral Disc Caused by Lumbar Puncture. A. H. Baker. *Brit. J. Surg.* 1947 34 385

A case history of an intervertebral disc arising from lumbar puncture is discussed. The patient was a 4 year old child who entered the hospital because of mild fits. Several diagnostic spinal punctures were done with difficulty at several levels along the lumbar vertebral column. About 1 week later the child had a severe backache, and a roentgenograph taken at this time showed no abnormality of the spine. After another week the pain was more severe and he had difficulty in sitting and walking. Roentgenograms were thereafter taken at intervals and showed a gradual narrowing of the spaces between the second and third and between the third and fourth lumbar vertebrae. The condition was successfully treated by plaster immobilization.

The author believes that such an injury is more likely to occur in a child than in an adult because the nucleus pulposus is more liquid and can seep through a ruptured annulus.

DANIEL ROCK, M.D.

Variations in the Syndrome of the Ruptured Intervertebral Disc in the Lumbar Region. Frederic V. Kristoff and Guy L. Odum. *Surgery* 1947 23 83

The authors have described the classical picture with regard to symptoms and neurological findings in the average single dislocated intervertebral disc. They point out the fact that there are variations in the clinical syndrome associated with other types of rupture of the intervertebral disc, with complications and progressive changes in the more simple types. The conditions outlined as responsible for such variations are classified as follows: (1) the rupture has taken place higher than the fourth lumbar interspace (2) lateral protrusion has not occurred or the protrusion is large enough to affect more than one or two nerve roots (3) the protrusion has been bilateral (4) 2 or more adjacent discs have ruptured (5) the main bulk of the ruptured disc is no longer attached to its intervertebral space but has wandered into the spinal canal (6) the protrusion is so massive that it completely blocks the spinal canal and thus produces the syndrome of the cauda equina.

Ruptures at higher levels as outlined above, in (1) may produce localized back pain without radiation over a radicular distribution.

Central protrusions are more apt to give localized back pain without radiation in view of the fact that they do not produce direct compression of a single nerve root. If this condition progresses to complete extrusion and obstruction of the canal one then finds a syndrome with the cauda equina as described under (6), with marked motor loss below the knees and as a rule loss of bladder and bowel control.

The bilaterally protruding disc (5) would, as expected, produce bilateral radiation of pain into both lower extremities.

Multiple ruptures of discs may be unilateral or bilateral, with unilateral or bilateral radiating pain and symptoms suggestive of involvement of the nerve roots at more than one level.

Displaced cartilage which may wander in the canal (5) may produce changing symptoms and findings, although the earlier symptomatology is usually that of a unilateral single protrusion.

Myelography will assist materially in reaching a final decision as to the presence of such unusual type of disc derangements.

HOWARD A. BROWN, M.D.

Erosive Bone Lesions and Soft Tissue Ossification Associated with Spinal Cord Injuries. (Paraplegia). Norman Hellbrun and William C. Kuhn. *Radiology* 1947 48 579.

A study of 99 cases of paraplegia was made to evaluate erosive changes and soft tissue ossification. The authors have emphasized that such ossifications are not specific for spinal cord lesions, but may develop in many diseases involving the central nervous system.

The x-ray examination included in all cases stereoscopic films in the anterior-posterior projection of the lumbar spine, pelvis, and hips. In 55 per cent of the cases further views were obtained of the knee, ankles, and heels.

Of the 99 patients, 45 showed erosive bone changes other than osteoporosis, while 43 exhibited soft tissue ossification. Only 4 cases revealed ossification of the tissues without bony changes. The extent of the erosive changes was, in the majority of cases, directly related to the severity, size, and duration of adjacent disability.

Roentgen studies had been made, on the average, at least one year after the cord injury. Early ossifying lesions of the soft tissue were not seen, but the authors believed that in all probability the deposition of a "flocculent, nebulous or streaky amorphous calcium" was the initial phase of the process. Ossifications are usually found near the larger joints but may occur in muscles, tendons, sheaths, ligaments, joint capsules, or be adherent to the periosteum. Although new bone may be contiguous to the periosteum it neither arises from nor affects it. Once a mature trabecular pattern is established the size of the ossification remains constant in the paraplegic patient, and regression does not occur. These soft tissue changes are never seen above the level of the spinal cord lesion.

The distinctive x-ray changes were first the erosive changes leading to the loss of normal contour of bone, as in the trochanter with flattening followed by reshaping and repair with the formation of an abnormal contour by proliferative and exuberant bone. Secondly there was complete lack of involvement of the joint surface or a decrease in the size of the joint space. All cases showed varying degrees of osteoporosis.

Biopsies of trochanteric bone from 10 patients enabled evaluation of the erosive process. All showed extensive subacute or chronic infection of the soft

issues with extension to the superficial portion of the bone. Within the bone itself there was increased asclerisation with gradual invasion of the marrow spaces by fibrous and vascular tissue. Finally there was progressive atrophy and resorption of bone and in a few cases, osteomyelitis with sequestration. There were no joint changes suggestive of neuroarthropathies and the question was raised whether this might not be due to the fact that paraplegic patients are not subject to the trauma of ambulation.

Etiological factors for the soft tissue ossification were discussed. Trauma was suggested as a probable underlying cause but the authors have pointed out that the neurogenic influence cannot be disregarded because of the great incidence of these lesions in neurological disorders. They suggested that trauma to the connective tissue might serve as a trigger mechanism in the development of the calcification when there has been disturbance of the nerve supply.

RICHARD C. SCHWEIDER, M.D.

SYMPATHETIC NERVES

Arterial Hypertension. Sven Hammarström. *Acta med. scand.* 1947 125 Supp. 192

The present monograph, dealing with the general subject of hypertension, is a combined study of the 134 patients in the series of the author, all of whom were studied on the medical service of St. Erik's Hospital, Stockholm. It is, as well, a digest of current thought and methods in the study and treatment of this disease. Many of the author's patients (101, or 75%) were treated by sympathectomy. In the first year all patients were operated upon by supradiaphragmatic sympathectomy only but all patients thereafter were treated by the more extensive supra-diaphragmatic and infra-diaphragmatic sympathectomy. The author is inclined to believe that the

more extensive operation is the more effective, but he makes the pertinent observation that the large series of results published by both Peet and Smithwick show essentially the same figures.

The height and variability of blood pressure in essential hypertension were studied by means of 24 hour readings, sodium amytal injections, nitrite administration, and cold pressor tests. The author separated his patients into three groups: patients with normal fundi, patients with arteriosclerotic eye-ground changes, and patients with frank hypertensive retinopathy. The author found no parallelism between the height of the blood pressure and the 24 hour variations. He does not consider the cold pressor test suitably standard for clinical purposes. There is a close correspondence between the spontaneous variability and the drop in blood pressure during the amytal test. In patients with hypertensive eye-ground changes the variation calculated according to nitrite tests is greater than the spontaneous variability while there is a close correspondence in those with normal eye grounds. In the author's experience vascular changes in hypertension are of greater prognostic importance than the height and variability of the blood pressure.

A general discussion of the methods of selection of patients for surgical treatment, the necessary pre-operative study and operative results the world over is given in a thoughtful, nonopinionated manner. The author has appended the summarized case histories of his operative patients and has assembled an excellent and up-to-date list of references from the current literature. The translator of this paper is to be congratulated since the English lacks many of the common grammatical errors in such reports. Altogether the monograph is recommended to any person interested in the broad subject of hypertensive disease.

JOHN MARTIN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Anatomic and Clinical Types of Mammary Tuberculosis. Tuberculous Galactophoritis. (Les formes anatomocliniques de la tuberculose mammaire. La galactophorite tuberculeuse) Jacques Delarue, Jean De Bruix, and J. P. Kerneis. *Ann. anat. path.* Par 947 7 146

Although mammary tuberculosis would appear to be a rather rare condition, only 473 cases having been collected up to 1936 the number of cases recently reported suggests that the disease may be more common than hitherto suspected. Diagnosis may require histologic examination. The authors present 18 cases of mammary tuberculosis, including an exclusively galactophoric type, to demonstrate the influence of mammary physiology and, in particular premenstrual congestion, on the local determinism and developmental stages of tuberculosis.

Clinically one may have to deal with exclusive involvement of the perimammary connecting spaces (paramastitis) or with lesions of the glands themselves, either of the deeper structures, or of the superficial perimammary region. Paramastitis is not mammary tuberculosis in the strict sense of the word, but consists of lesions of the thoracic wall in the mammary region.

Genuine mammary tuberculosis may be of the deep glandular type and may be diffuse or circumscribed the latter simulating fibroadenoma, sclerocystic mammitis or nodular cancer and frequently alluded to as pseudoneoplastic mammary tuberculosis—a superficial condition, of perimammary location. Most writers recognize lesions of the milky granulomata, abscesses, and sclerotic types. An attempt is made to draw a parallel between certain clinical aspects of the condition and the anatomicopathologic lesions in genuine mammary tuberculosis.

Milary tuberculosis of the breast is a rare localization of generalized milary tuberculosis. The authors observed the condition in 3 patients during lactation. It appears in isolated foci the size of a pinhead and is yellowish white in color. Histologically these lesions are intralobular: otherwise they are similar to the lesions of milary tuberculosis of other organs.

Genuine mammary tuberculosis may appear as a suppurative caseous focus, a veritable intramammary cold abscess, the size of which may vary from that of a nut to that of an orange, with a central cavity and one or several diverticula apparently corresponding to the galactophorous ducts. The rest of the gland is usually intact, occasionally it is the seat of a sclerocystic dysplasia. The cavity contains a yellowish gray or greenish grumous pus, with abundant fatty bodies and numerous Koch bacilli. The central cavity is bordered by an occasionally very thin margin which, on histologic examination, is shown to have a substrate consisting of a very thin

layer of caseous necrosis edged with epithelial cells in palisade arrangement.

Tuberculous mammary lobulitis is the substrate most deep circumscribed or diffuse types of mammary tuberculosis. The distinguishing features are integrity of the galactophore and of the periductal conjunctivoadipose tissue. The histologic features are described in detail. The lobulitis may be caseous and suppurative, or fibrous and hyperplastic, the latter being seen most frequently and comprising about 30 per cent of all cases of mammary tuberculosis.

Superficial perimammary mammary tuberculosis is a tuberculous galactophoritis other tissues remain intact. Histologically one may have to deal with circumscribed galactophoritis, with distended lactiferous ducts with pus proceeding from the caseified wall, or with vegetating galactophoritis with intracanalicular papillary vegetations, in which the bacilli are numerous. This is to deep tuberculous lobulitis and intracanalicular cancer is to deep mammary cancer. Associated lesions may include sclerocystic dysplasia or mammary cancer.

Mammary tuberculosis is an external hemipneumous form of tuberculosis which does not come with pulmonary tuberculosis. The minimal pulmonary lesions are the same as those observed in other forms of external tuberculosis, therefore the appearance of a mammary tumor in a patient with pulmonary tuberculosis should raise the suspicion of cancer rather than of mammary tuberculosis.

Opinions have been divided as to the mode of dissemination in mammary tuberculosis, the idea of a glandular invasion giving way to that of lymphatic and hematogenous spread. In deep or superficial glandular tuberculosis, however, the hematogenous route seems confirmed. The authors draw attention to the influence of certain nonspecific local favorable factors, and suggest that tissue biology may be more important in determining the lesions than the mode of dissemination and diffusion of the bacilli.

Finally the authors discuss the relation between mammary tuberculous lesions and the physiologic activity of the gland. Exacerbation of the disease during menstruation has been observed. With the exception of certain forms, mammary tuberculosis occurs only during the period of genital activity. The influence of lactation is manifest and milk is said to form an excellent culture medium for the bacilli. In 3 of the cases in the present series, tuberculosis of the breast developed 1 month after the beginning of lactation in 1 patient, and in 6 months after the beginning of lactation in 2 patients.

The effect of the menstrual cycle is still more important. During the last days of the cycle the patient complains of a painful tension in the breast and more severe pain than usual in the involved breast. The swelling is increased. In a case of galactophoritis, a cyclic course was noted. On the eighteenth day

of the cycle a sensation of painful tension was noted with redness at the site of the fistula on the twentieth day a clear serous fluid escaped from the fistula. On the twenty first day this was replaced by pus which persisted to the twenty-eighth day when the discharge ceased suddenly. The fistula closed on the fourth or fifth day of the period. These phenomena were repeated for 8 months and failed to respond to ultraviolet rays or vitamin A therapy. Bacilli were not found in the serous discharge but appeared in the pus escaping from the twenty-second to the twenty-eighth day. On the last day the discharge became sterile. Only the injection of male hormone in doses of 50 mgm. per month for 3 months during the second quarter of the menstrual cycle prevented these symptoms, and the patient has remained well for 1 year. Thus, folliculin seems to favor tuberculous activity possibly via the local angioneurotic vascular system. It is evident therefore that the course of mammary tuberculosis is influenced by hormonal factors. This is another proof that local nonspecific factors play a part in determining the course of mammary tuberculosis.

ENTRÉ SCHEMATIC MOON

TRACHEA, LUNGS, AND PLEURA

Reflex Infection, Pulmonary Re-Expansion and
Resorption Pulmonary Retraction (Infection pleura,
Sera) Marcelle Roux Berger Blanchy J. Méd
Chir., 1947 : 97

The end result of a pleural infection may be a residual abnormal pleural space or an adhesion of the re-expanded lung to the thoracic wall. The former may remain aseptic. Thus superinfected pleuritis during the course of pneumothorax may be cured by pleural lavage following which the therapeutic collapse can be maintained. Primary pyogenic consolidation on the other hand are likely to heal with re-expansion of the lung which becomes adherent to the thoracic wall. This symphysis prevents recurrence. Should the suppuration fail to respond the infection and pulmonary retraction persist. Attempts at treatment of the pulmonary retraction by physical methods rarely lead to complete re-expansion. The only logical treatment in cases in which the suppuration has become chronic consists in the excision of the infected tissue and destruction of the septic areas. Physical therapy cannot take the place of prompt disinfection and pleural aspiration under these conditions may prove dangerous.

The author stresses the fact that in most cases of pleural infection in which the lung fails to re-expand there is another factor besides the pathologic and toxic condition to consider namely a temporary independent obstacle of a functional nature. This is after its removal. It is due to the effect of the pleural inflammation on the subjacent organ and muscles surrounding it. An illustrative case is described in detail. In this case the intricate local and functional

signs included a parietal reaction leaving one half of the chest flat and immobile with marked lowering of the shoulder marked diminution of the intercostal spaces and rapid superficial upper costal respiration even on the normal side. There was a bilateral contraction of the diaphragm with immobilization in the position of inspiration. A superficial spasmodic cough followed the slightest movement of deglutition speech or deep respiration. The pulmonary retraction was very rapid and attempts at pleural depression were followed by epigastric pain spasmodic cough and immediate pleural hemorrhage. As soon as the pus into a serofibrinous fluid indicated control of the infection the pulmonary retraction disappeared, with simultaneous disappearance of the parietal and diaphragmatic reactions. This pulmonary reaction to an inflamed serosa resembled acute peritonitis. The only effective treatment consisted in suppression of toxic resorption by abundant, frequent and antiseptic pleural irrigation.

This early apparently reflex, pulmonary reaction evidently depends more upon the suddenness and severity of the pleural involvement. The virulence of organisms, intensity of inflammation than upon the amount of effusion. It does not occur in pyogenic pleuritis. Some pleuritis occurring during pneumothorax treatment for tuberculosis run a very acute course with fever, cough, dyspnea, vomiting and complete gastric intolerance for several days. They are then accompanied by the described early pulmonary retraction. The effect of lavage is not influenced by the duration of the retraction since the latter preserves its functional character as long as the pleural infection remains curable. In cases of long standing it may be difficult to determine whether the functional nature of this active reflex, temporary retraction is still preponderant or whether it has been replaced by a sclerosis. Even sclerosis may retrogress in cases are described illustrating the remarkable capacity of the lung to re-expand once the cause of suppuration has been removed. Treatment of osteitis in one case and excision of a costal focus of infection in the other led to recovery when other methods had failed.

The function of reflex retraction in response to physical chemical or electric stimulants and of expansion under the influence of pharmacodynamics has therefore to be considered as well as the physiologic and respiratory functions of the lung. It is emphasized that pleural dysfunction should therefore take precedence over mechanical measures for pulmonary re-expansion. In the serofibrinous pleuritis thorax pleuritis early copious irrigation should be used in preference to puncture and aspiration. In superinfected pneumothorax pleuritis such irrigations must be used very early and daily in order to leave no trace of pathologic fluid in the pleura. The irrigations should be done with 2 needles as far as possible from each other the lower one at the lowest

anterior or posterior point of the focus as determined by a lipiodol guide. The upper needle insures a free circulation of air above the fluid. Attempts at pleural depression will lead to pleural hemorrhage which favors microbial proliferation. Irritating substances such as antiseptics must be used with caution. Penicillin is so well tolerated that it supplants all other drugs for this purpose. It is, however, not always adequate in severe infections without total evacuation. In primary pyogenic pleuritis, drainage should be made from the lowest point after lipiodol orientation, since any retention however minimal will hinder recovery. Daily irrigations should be made to free the pleura from pathologic secretions before penicillin is introduced. Continuous aspiration insures permanent drainage, but the probe must be in the cul-de-sac and watched so that it does not cause hemorrhage or the slightest malaise. It must not be used alone or in preference to the other methods described. The procedures insuring best and earliest pleural disinfection are those leading to most rapid pulmonary re-expansion with symphysis and definite cure, whatever be the pleural pressure left in free communication with the exterior.

ESTHER SCRAMER MOORE.

Thoracoscopy and Pneumothorax in Pulmonary Tuberculosis. Walter E. Kunzler. *J Thorac. Surg.* 1947 6 353.

Every patient with pneumothorax should be closely guarded against possible complications, and should be submitted to thoracoscopy as soon as direct or indirect signs of adhesions are detected. Indirect signs are (1) the presence of fluid in the costophrenic angle (2) insufficient collapse of diseased lung tissue, cavities, and persistence of positive sputum, in spite of regular and apparently sufficient refills and (3) partial shift of the mediastinum. Direct signs of adhesions may be recognized only at a later date, but expiratory x rays, oblique aereo x rays, tomograms, and outlining of the esophagus by radiopaque substances make it possible to establish such a diagnosis before indirect signs are available.

Thoracoscopy is a harmless procedure. Its only potential complications are subcutaneous emphysema and hemorrhage from the trocar puncture. General anesthesia is of definite disadvantage. Local infiltration with novocaine is the anesthetic of choice.

Adhesions should be divided if (1) they are responsible for an insufficient collapse of the diseased part of the lung or (2) if they are suitable for separation without anticipation of complications, such as injury to lung tissue, rupture of residual adhesions, perforation of cavities, and hemorrhage. Adhesions of major caliber or multiple small adhesions should not be divided if selective collapse is possible, especially in bilateral cases.

Multistage operations should be attempted only if no other procedure is feasible, if intrapleural pressures are well controlled and if prevailing circum-

stances permit a further stage at any time considered optimal for the individual case.

The determination of vital capacity or of oxygen consumption of each lung separately (pneumometry) should be done in the presence of bilateral disease. Bronchoscopy should be performed in all cases before institution of pneumothorax, if this is possible.

Pneumothorax should be abandoned immediately if (1) important adhesions are not suitable for entry and other procedures (thoracoplasty, lobectomy, pneumonectomy) (2) fluid and high fever develop and persist for more than a few days, (3) conditions which predispose to the development of emphysema are present, especially injury to the lung by its cavity rupture of residual adhesions, or of a cavity and extensive active disease of the lung (4) oxygen consumption is below the minimum compatible with light exercise (5) tension cavities are present. In bilateral far advanced cases, with severe repeated hemorrhage originating from the pneumothorax, however it may be advisable to continue the pneumothorax.

In 75 per cent of the series of 500 cases reported, pneumonolysis converted a pneumothorax which was questionable or dangerous, due to adhesions, into a safe and satisfactory collapse of the lung. Favorable results from pneumonolysis are dependent on the skill of the operating surgeon. Experience is important, since teaching of the technique is rather difficult, due to the endoscopic nature of the procedure.

SAURITZ KUNZ, M.D.

Lung Resection for Pulmonary Tuberculosis. Charles Philmore Bailey. *J Thorac. Surg.* 1947 16 323.

This article presents a general and far moving discussion of the use of resection for tuberculous pulmonary lesions. The feeling is expressed that it is a justifiable procedure deserving of accurate appraisal. The author states that it is "under some cloud because of the dramatically poor results first obtained." Further experience may clarify the indications and many of the details in management.

The most common causes of mortality and morbidity are given as (1) asphyxia during operation by flooding of the airway with released secretions, (2) spread of the disease to other areas, (3) hemorrhage or shock, (4) opening of the bronchial suture line, (5) tuberculous empyema, (6) pyogenic empyema, (7) combinations of items (4) (5) and (6) and (8) marked deviations from normal of intrathoracic pressure levels postoperatively.

The prevention of these complications is discussed. Items (1) and (2) being closely related, can be minimized by proper positioning on the operating table so that the secretions are not allowed to gravitate in such a way as to invade uninvolved segments of lung.

A special technique of endobronchial catheterization has been worked out in order to prevent the secretions from entering these segments. This tech-

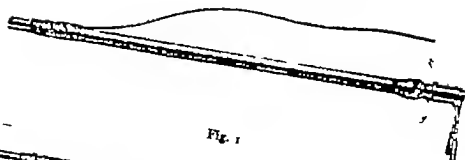


Fig. 1

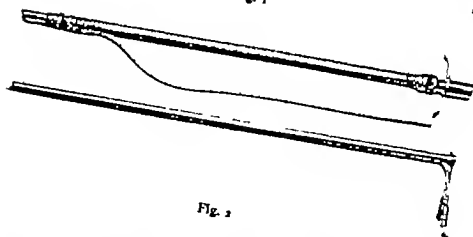


Fig. 2



Fig. 3

Fig. 1 (Bailey) Direct vision endobronchial catheter obturator in place. The rubber sheath has been drawn back from the tip to show the coil spring construction. Note inflatable cuff.
 Fig. 2. Obturator removed. It is really a 5 mm. bronchoscope with a built-in light carrier and oxygen delivery tube. Battery cord is connected to terminal.
 Fig. 3. Flexibility of tube after removing obturator. This decreases trauma to the air passages.

unique is adequate in numerous situations but has the undesirable feature for example of occluding the orifice of the upper lobe when the right side is intubated. The author uses it in total pneumonectomy and lower lobectomy chiefly.

Hemorrhage and shock are combated by the usual means.

The closure of the bronchial stump is accomplished by a row of end sutures of fine silk or stainless steel wire, reinforced by a second proximal row which reduces the tension on the end row. The line of resection is then treated with plasma and thrombin and covered by pleura or other suitable available tissue.

Prevention of empyema involves adequate cleansing and dressing of the pleural cavity in the event of contamination and prompt re-expansion of the lung following lobectomy. This can be greatly enhanced by negative pressure drainage; reduction of the size of the hemithorax by phrenic nerve interruption and/or thoracoplasty. These various procedures

are discussed as to their relative indications and usefulness.

The mechanism of changes in intrapleural pressures postoperatively, the dynamics of cough in the face of surgically produced alterations of function, and the attendant effect on the control of bronchial secretions is elaborated upon.

The author's experience comprises 80 cases treated by resection for a variety of pathologic states in tuberculosis. The mortality is given as 36.5 per cent for pneumonectomy and 35 per cent for lobectomy; there was none for segmental resections. The over-all mortality is estimated at 27.5 per cent. Since operative complications may not cause death for months or years, it is difficult to estimate the actual operative mortality, but the author believes that a reasonable estimate of mortality from resection for cases in which no other form of treatment is possible should be around 20 per cent. At present 68 per cent of the living patients have negative sputum and are well.

HIRSH T. LANGSTON, M.D.

Cysts of the Pulmonary Pedicle (Les kystes du pédicule pulmonaire) P. Santy M. Bérand, and P. Galy *J. méd. chir., Par* 947 66.

In addition to dermoid cysts of complex structure involving multiple tissues one may also encounter in the mediastinum, or its immediate vicinity congenital cysts of more simple structure involving tissues only of a single organ. The latter develop later in embryologic life. They may be epidermoid cysts, pleuropariocardiac cysts cysts derived from the digestive tract or bronchiogenic cysts of the pulmonary pedicle. The authors describe 4 cases of the latter type in which surgical removal of the cysts led to recovery. A review of the literature shows that about 30 such cysts have been discovered at operation in adults. Also teratological malformations in fetuses and young infants have been reported. This type becomes manifest very early because of symptoms of compression. A brief résumé of cases reported by other writers is presented. The patients in the present series were 16 11 34, and 38 years of age respectively. The smaller cysts are usually juxtamedialastmal but as they grow larger may assume variable positions and may be encountered at the level of the tracheal bifurcation, upper hemithorax, at the base of the thorax, especially on the left side, or in the interlobe. The position varies according to the site of implantation of the cyst and its stage of development. Cysts of the lobar pedicle usually have a more insidious course. Some cysts appear to have only a distant relation to the pedicle as in 1 of the present cases in which the cyst was located in the triangular ligament.

Macroscopically the walls of these cysts appear smooth thick, and whitish or slightly pink, and are often covered with vessels of considerable size. On section they prove resistant and are found inseminated with tiny islets of cartilaginous tissue. In none of the cases described was there any wide direct communication between the cyst and the large bronchi of the pulmonary pedicle but in 1 case a small communication existed between the cyst and the bronchial tree. Broad communications were described in only 1 cases in the literature. As a rule, there is no communication and especially not in infants and young children. The cyst may be free of any adhesion outside of the pedicular zone or may have important connections with large vessels. Occasionally there may be dense adhesions to adjacent pulmonary lobes or the pericardium usually associated with infection. In most cases the contents of the cyst are a thready glairy mucus, usually described as sticky. In rare cases it may be a yellow fluid. In 1 of the cases reported, it contained flakes of cholesteroline. If the cyst becomes infected puncture will yield pus.

Histologically the inner surface of the cyst wall is lined with ciliated cylindrocubical epithelial cells of bronchial type. In infected cysts this lining may be partially or almost completely desquamated. In some cases the lining appears to have undergone a transformation, which suggests a possible transition

to epidermoid cyst or secondary local metaplasia. The wall of the cyst contains also different degrees of normal bronchial tissue. The organization of these elements and their greater or less relative importance permits classification into 3 distinct types which are described in detail.

These types include (a) an aspect much like that of normal bronchial tissue, (b) a more complex aspect, seen in larger cysts, produced by an such disposition of the various planes and excessive development of certain structures. In particular the cartilaginous and (c) certain other aspects which are much less complex and differentiated.

Cysts of the pulmonary pedicle are caused by maldevelopment of the bronchopulmonary system in the division of the bronchial tree. They are believed to have their origin in an accessory rudimentary bronchial bud. In some cases there may be malformation of a normal lobe or an accessory pulmonary lobe, while in other cases there may be a supernumerary lobe accompanied by cystic bronchial malformation.

Clinically these cysts may remain silent or they may be associated with vague malaise pain in the chest or epigastrium stubborn cough, dyspnea and bloody sputum. The symptoms are more severe in association with the larger cysts and are often exacerbated in certain positions or changes of position. Roentgenologically the shape of the cyst changes with change of position. Painful reflex changes as well as vascular reflexes causing hemoptysis, as well as release by traction on the peribronchial nerve plexus. If infection develops, the picture becomes that of chronic pulmonary suppuration. Progressive enlargement of the cyst seems common, and in late cases has proceeded for periods ranging from 10 to 25 years. Compression, infection, and hemorrhage supervene. For this reason a pedicular cyst should be surgically removed as soon as diagnosed regardless of the symptoms.

Diagnosis depends chiefly on the x-ray findings. The technique and interpretation of roentgenography for this purpose are discussed.

Artificial pneumothorax is another diagnostic technique although not always possible because infected cysts often lead to emphysema. A clear demarcation between the retracted pulmonary lobes and the cyst may be demonstrated in fairly large cysts. In smaller cysts no such demarcation is observed and it may be impossible to determine whether the tumor is intraparenchymatous or extraparenchymatous. Changes in the shape of the tumor may, however, aid in the diagnosis of a cystic structure. Once pneumothorax has been attained pleuroscopy will reveal the location of the cyst, its shape dimensions, and relation to the diaphragm and adjoining pulmonary lobes.

Bronchoscopy or lipiodol bronchography may be of value in eliminating the bronchi as the origin of hemoptysis, or in disclosing a bronchial anomaly or the opening of a supernumerary bronchus, or some anomaly in lobar distribution. Caution is urged in

the use of bronchography once operation has been decided upon because retention of lipiodol in the alveoli may give rise to postoperative complications. Differential diagnosis from atypical pleurisy and intrapulmonary tumor encysted pneumothorax, supradiaphragmatic encysted pleurisy, cancer hydatid cyst, and nonparasitic pulmonary cysts is discussed. Diagnosis may be impossible without thoracotomy in some cases. A fluid level is rarely found in a pedicular cyst. In differentiation from intrathoracic but extrapulmonary tumors pleuroscopy will eliminate diverticulum of the pericardium, neurofibroma, dermoid and epidermoid cysts the latter usually defying diagnosis before operation. If thoracotomy fails to reveal the true nature of the cyst histologic study may be required.

Treatment is purely surgical and should not be delayed once the cyst has been diagnosed. When vascularization or aeration of the adjacent pulmonary lobes renders complete removal too dangerous it is justifiable to open the wall of the cyst, remove most of it, and leave the adherent portion *in situ*. Subtotal excision is preferable to lobectomy or pneumonectomy.

The results obtained with excision are excellent. All 4 patients in the present series recovered even though lobectomy was required in 1 case. The lesion does not involve the pulmonary parenchyma and excision entails no functional mutilation.

EMILY SCHAEFER MOORE

HEART AND PERICARDIUM

Surgical Treatment of Pericarditis Constrictiva

Kaare Lannung *Acta chir scand* 1947 95 440.

The author reports on the surgical treatment of 9 cases of pericarditis constrictiva. Cardiolytic was performed on 2 patients and one of these died a few hours after the operation. In the patient who survived there was no effect from the operation. In 7 cases, partial pericardiectomy was performed. There was no postoperative death. In 4 cases a considerable improvement followed the operation. All 4 of these patients are fit for work and are practically symptom free.

In 3 cases the period of observation has been long viz., 5 to 8 years. In the fourth case it has been only some months. In 1 of the 3 remaining cases the result may be good but the period of observation is too short. In 1 case it is doubtful that any effect will follow the operation. In 1 case the operation had no effect and this patient died 3 years after the operation.

It is recommended that the operation be performed under intratracheal narcosis and that a dorso-lateral transpleural incision be used as this gives a good approach to the heart, and a thoracic wall can be reconstructed after the operation. It is further more recommended that operation be performed at a sufficiently early stage in the disease before irreversible changes in the liver and myocardium have occurred.

JOHN J. MALONEY M.D.

Results of Pericardiectomy in the Syndrome of Pick.

(Resultados alejados de la pericardiotomía en el síndrome de Pick) Arnaldo Yódice. *Bol Acad argent cir* 1947 31 395

In a study of 7 cases of compressive pericarditis (Pick's disease) the author has found tuberculosis as the etiological agent, although there are some cases of infectious pericarditis due to common organisms.

With the fibrinous reaction the pericardium undergoes a constrictive process which little by little compresses the heart and interferes with diastole. This results in increased venous pressure and brings about hepatomegaly which in turn gives rise to increased pressure of the portal system and results in ascites and edema of the lower extremities. The ensuing hepatic cirrhosis is believed to be due to the hepatic congestion.

Patients with constrictive pericarditis and ascites show the following symptoms: general debility, fatigue, dyspnea on slight exertion, swelling of the abdomen, venous engorgement, cyanosis, dyspnea on recumbent position and dilatation of the jugular veins and the veins of the hands and forearm. The pulse is generally rhythmic and regular and has a rate of 60-100 while in the cases with tachycardia, it signifies myocardial damage and a sign of tuberculous pericarditis. Pulsus paradoxus is present in nearly all cases. The arterial pressure is low (100-120 mm) and is associated with a low pulse pressure (30-35 mm). The venous pressure varies directly with the cardiac compression, ranging between 15 and 42 cm of physiological saline solution. There is a direct relation between the degree of ascites and the venous pressure.

The fibrous pericardium prevents the transmission of the apex beat in systole. The heart tones are muffled and lessened while the electrocardiogram shows low voltage and a serrated Q.R.S. On roentgenography the principal signs are the narrowing of the width of the heart and the absence of diastolic dilatation. Calcification of the pericardium is observed in 25 per cent of the cases while in the author's series it was found in 4 of 7 cases. Hydrothorax signifies a tuberculous pericarditis.

This disease must be differentiated from tuberculous peritonitis, hepatic cirrhosis, asystole and hypostyle.

Ample pericardiectomy is indicated except in poor surgical risks, or patients with a high temperature. Preoperatively the patient should have a salt free diet and digitalis if tachycardia is present. The anesthetic used was nitrous oxide with a little ether. After the heart is approached the fibrous pericardium is dissected from the apex to the base and to the great vessels. During this maneuver the heart reacts with extra systoles which if too frequent indicate a period of rest. Drainage to a dependent point is used and the wound is closed in layers.

Complications during surgery are as follows: acute dilatation of the heart and ventricular fibrillation which may be treated with electric shock therapy. To prevent immediate postoperative complication

the patient should be placed in an oxygen tent for 3 days, and cardiac tonics and penicillin should be administered.

The cure is of the Pick's disease, but not of the underlying tuberculosis. In the author's series all of the patients recovered except 1 who had millary tuberculosis.

ARTHUR F. CIPOLLA, M.D.

ESOPHAGUS AND MEDIASTINUM

Diverticulum of the Esophagus. A. C. Furstenberg.
Ann. Otol. Rhinol. 947 50 305

Pharyngoesophageal diverticulum is a herniation of mucous membrane through a weakened region at the junction of the inferior constrictor and the cricopharyngeus muscles. An obstruction of the esophagus contributes to its development. The diverticulum can now be safely removed in a one stage operation because of the effectiveness of sulfadiazine and penicillin in preventing mediastinal infection. The technique of the operation is described in detail.

CLAYTON H. THORNE, M.D.

Megaeosophagus (II megaeosophago) A. Bonardies.
Arch. Ital. Med. Exp. Appl. 947 3 79.

The various theories treating with the etiology and pathogenesis of the esophageal dilatations, although usually backed by ingenious and thought provoking probative material, are largely repudiated by the author as either not explaining all the facts observed or as explaining all the facts in only a few selected instances. It is hard to see how the hereditary or congenital factors suggested in some of these theories could be present, at times to an advanced age without giving any evidence, or at least more than passing evidence of their presence. They could hardly represent more than a predisposing factor in the development of the disease. Even the assertion that the condition arises as a result of a continuing spasm of the sphincter surrounding the lower end of the esophagus seems implausible in the face of the fact that no special thickening of these muscles at this location has ever been demonstrated. The "cravatte" of muscular fibers described by Joanesco represents only a delicate muscular band on the anterior surface of the esophagus whose evident purpose is to anchor the esophageal tube and not to function as an accessory mechanism in the act of deglutition.

The idea that a tumor (cancer) acts as the blocking agent at the lower end of the esophagus is rendered implausible by the fact, among others, that the tumor when actually present does not tend to produce more than a slight dilatation of this tube moreover when the lower end of the esophagus in megaeosophagus is dilated by operative means the size of the esophagus tends to return to normal, whereas when the tumor is removed in those cases the dilatation remains. Those instances in which the tumor is actually found in a case of true megaeosophagus are more easily explained as a sequela of the irritation and trauma of the food material in over-

coming the dysphagia rather than as the cause of the dilated condition.

The author nevertheless, does not dismiss the possibilities in any of these suggestions, but before a number of different factors acting in concert must be considered. First, it must be assumed there is present a congenitally weak esophageal musculature which (combined perhaps with a malfunctioning of the vagosympathetic nervous system) might go along for years with disagreeing symptoms until a sudden fright or period of anxiety serves as the proximate cause of an acute attack. In this regard a case is cited of a 15 year old girl, who had always been well and of a gay and carefree temper, but who during an air raid at Palermo, developed inability to swallow and a radiologically dilated esophagus. This condition was later completely relieved by an insignificant dilatation operation during a period of residence in the relatively tranquil city of Rome. In this same case as interest in the possibility of reducing the patient's participation in the production of the syndrome by the fact that an ameporrhea developed, simultaneously and disappeared at the same time as the dysphagia.

Another instance suggesting the power of emotional stress in the production of megaeosophagus was communicated personally to the author by Professor Puri. It was that of an aviator whose plane was shot down in aerial combat. For a year this patient was considered a malingerer until radiology decided to dilated esophagus. This patient likewise was only relieved after the cessation of hostilities.

Finally there are cited the instances of a young man whose condition was relieved, apparently by the power of suggestion, following a dilatation attempt which unknown to the patient, had failed as the result of a technical mishap, and of a boy who screamed and struggled in the operating room and could not be persuaded to submit to the operation, but who was perfectly and permanently relieved.

Diagnostic probing of the esophagus is dangerous and as a rule, unnecessary. If the radiologic examination is insufficient to confirm the diagnosis the author resorts at once to the esophagoscope. Likewise, preliminary meddling such as antispasmodic medication is passed over in favor of immediate treatment with the dilating procedures. In many cases a large sound will be all that is necessary however the author has obtained most excellent results with the modern mechanical dilators. One patient was satisfactorily relieved by the Goldstein dilator (as modified by Einhorn), but most of the author's experience has been with the dilator of Starck. With this apparatus, one dilatation has usually been sufficient although an occasional recurrence after a year or so has been rectified by a second dilatation. No harm has ever been observed from the use of these machines. Radical surgery has been reserved for a few patients with impervious stricture or massive cicatricial narrowing who could not be relieved by nonoperative methods. JOHN W. BARNARD, M.D.

MISCELLANEOUS

Subdiaphragmatic Aberrant Pulmonary Tissue.
(Case Report.) Anibal Roberto Valle and M.
Lawrence White, Jr. *Dis Chest* 1947 13 63.

The authors report the case of a 9 month old colored male infant who had projectile vomiting of mucus and undigested food after nearly every feeding since birth. There was no choking, cyanosis or coughing associated with the vomiting. Bowel habits were normal. The child was mentally alert but was unable to gain weight normally. Atropine taken orally failed to relieve the symptoms and the patient was admitted to the University of Virginia Hospital for treatment of a suspected diaphragmatic hernia.

The child was poorly nourished and weighed only 10 pounds, 10 ounces. His temperature was normal. The abdomen was distended and tympanitic. The remainder of the examination was not contributory. All laboratory studies were found to be essentially negative.

Gastrointestinal roentgenograms showed a short dilated esophagus with a large gas-filled stomach, the cardiac portion of which protruded through a 2 cm. diaphragmatic defect near the esophageal hiatus. The remainder of the examination was found to be negative.

It is believed this patient had a diaphragmatic hernia, but the large tympanitic stomach suggested also increased vagal tone. Atropine was given for 15 days without much change in the clinical or roentgen picture.

Exploration was carried out through the eighth rib bed and an obvious posterior diaphragmatic herniation was found. The hernia was egg sized, herniated mass seemed to contain a nonreducible solid viscus. After opening the thin attenuated diaphragm, a dark red friable mass of tissue was seen. It was believed to be an ectopic kidney or spleen. Subdiaphragmatic exploration revealed a normal stomach, liver, spleen and kidney. The mass of tissue was dissected free from the diaphragm and posterior parietal peritoneum, with difficulty. There were numerous large vessels, apparently from the aorta, entering the mass. The mass was mobilized and removed. The defect in the diaphragm was closed with interrupted

silk. The child died suddenly as the chest was being closed, presumably from operative shock.

Postmortem examination revealed a small right kidney (10 gm.). No other congenital abnormality or explanation for the persistently dilated stomach was found.

The 4 by 3 by 2 cm. resected specimen was reddish brown with a cystic center 1 cm. in diameter containing bloody fluid. Microscopically the tissue appeared to be lung tissue with all alveoli filled with red blood cells. There was no pneumonia or neoplasia.

Two types of aberrant lung tissue are reported—the tracheal lobe in the upper chest, connected by a bronchus with the trachea, and the lower accessory lung in the lower chest or upper abdomen, consisting of sequestered pulmonary tissue having no connection with the bronchial tree. Thirty seven cases of the latter type, including the author's, have been reported. These cases are listed with information as to the side, whether above or below the diaphragm, and whether associated with a diaphragmatic hernia.

This anomaly is not incompatible with life, 1 case each being reported in patients 6, 18 and 47 years of age. Only 4 in the series were found on the right, and in 11 cases diaphragmatic hernias were associated. The author's case is the sixth one of hernia occurring beneath the diaphragm, the second in this location associated with a diaphragmatic hernia, and the first one diagnosed during life by an exploratory laparotomy.

There are many theories about the formation of aberrant lung tissue. Cockayne and Gladstone suggested that during certain embryonic stages, adhesions occur between the lung mesenchyma and the celomic mesothelium. These adhesions cause the living mesenchyma to be displaced downward along with the foregut. This would possibly account for the formation of a diaphragmatic hernia and the attachment of the accessory lung to the lower esophagus and stomach seen in the author's case.

The second theory is based on the possibility of the development of a second primitive respiratory tract from the digestive tract. This could be accomplished by a downward displacement of cells from the tracheoesophageal ridge with the growing foregut.

ROBERT R. HIGGINS, M.D.

SURGERY OF THE ABDOMEN

GASTROINTESTINAL TRACT

New Technique for Studying the Cytology of Gastric Aspirates in Man. Franklin Hollander, Manfred Hess, and Herbert A. Sober. *J Nat Cancer Inst.* 1947 7 365

The authors previously studied and reported the impairment of the mucus barrier in dogs including the attendant desquamation. If the response of the human stomach to mild irritation is analogous to that of the dog, then the introduction of an irritant into the gastric cavity of man should similarly induce greater quantities of desquamated epithelium than can be aspirated from the unstimulated fasting stomach. The present report is a discussion based on the collection of gastric aspirates following suitable stimulation of the mucosa, and the cytologic study of smears prepared from them.

A 3 per cent eugenol water suspension was used as the stimulus in fasting human subjects. The exact technique of aspiration at intervals is described. Smears from each sample were prepared and air dried without other fixation. They were stained with toluidine blue. The technique differed considerably from that reported by Papanicolaou but the methods will be used in systematic studies on human beings. There was a considerable yield of mucoid material. Mild irritation resulted in a striking increase in desquamation of individual columnar cells, clumps, and ranks of these elements. Squamous epithelial cells, leucocytes, and bacteria are also frequently noted in smears. In addition to being an aid in the study of the physiology of gastric mucus secretion in man, the finding that cancerous cells can be desquamated by eugenol may prove of value in the diagnosis of adenocarcinoma in the early stages of its development.

HARRY W. FOX, M.D.

A Review of 112 Cases of Congenital Hypertrophic Pyloric Stenosis. R. McLaren Todd. *Arch. Dis Childh.* Lond., 1947 22 75.

Congenital hypertrophic pyloric stenosis is one of the common diseases encountered during the first few weeks of life. When a survey of the literature is made, the wide variation of the mortality rate reported with both medical and surgical treatment is striking. An attempt was made to discover the factors which determined the success or failure of the treatment adopted from records of various observers. It appeared that one of the main causes of failure was inadequate attention to the details of treatment.

From a study of 112 cases, certain conclusions as to treatment were drawn and some interesting results of the roentgenological follow-up were noted.

One hundred and twelve cases of congenital hypertrophic pyloric stenosis treated medically are presented. Series A comprises 40 consecutive cases with 2 deaths, and series B comprises 72 cases treated at

the same hospital over an 8 year period with 6 deaths.

Particular stress is laid on the observation of definite routine, whichever method of treatment is employed.

The cases in series A were followed up clinically and roentgenologically. The subsequent physical and mental development of the patients was in no way affected by the pyloric stenosis, but the delay in emptying time of the stomach when seen at the follow-up examination was proportional to the severity of the condition as judged by the length of hospital treatment.

The cases in series B were followed up clinically and some of the patients were submitted to roentgenological examination. The results tend to confirm those of series A.

The following rules regarding the method of treatment should be employed in cases of congenital pyloric stenosis:

1. Medical treatment should be routine unless the patient is grossly dehydrated.
2. Surgical treatment should be undertaken if medical treatment is ineffective after a 7 day trial, unless the patient has an infection.
3. Surgical treatment is indicated in patients who are grossly dehydrated when first seen, or whose birth weight was below 6½ pounds.
4. Surgical treatment is contraindicated in an infected patient because of the risk of fatal gastroenteritis.

CHARLES BAXON M.D.

The Nutritional State of Patients with Peptic Ulcer as Measured by Vitamin Levels in the Blood and Urine. David Cayer and Sophia Cady. *Gastroenterology* 1947 9 54.

Disturbances of nutrition in patients suffering from gastrointestinal disorders, particularly with vomiting, deranged motility and self-imposed or therapeutic dietary restrictions are well recognized. As a result, an increased interest in dietary therapeutics has been of marked benefit to the patient. An unfortunate result, however, has been the overly enthusiastic and needless administration of expensive vitamin preparations to many patients in whom there is no indication for such treatment and who, therefore, can expect no improvement from the therapy. Indeed, who may at times show vague or definite gastric symptoms because of the medication.

On the basis that current laboratory methods for the determination of vitamin levels in the blood and urine were a fairly accurate measure of nutrition, and that the findings of such tests correlated with clinical evidence of vitamin deficiency, the authors have utilized these procedures to study the nutritional status of a group of 20 male patients suffering from active, recurrent peptic ulcer as compared to a control group of 15 patients without gastrointestinal disease.

The authors found that as a group patients with peptic ulcer were not likely to have deficiencies of vitamin A, niacin, or riboflavin a tendency which is in keeping with the infrequency of clinical signs of vitamin lack in such patients. Vitamin A and riboflavin are supplied adequately in the large amounts of milk which most ulcer patients consume and the normal amounts of niacin excreted in the urine of these patients possibly is due to a liberation from the body stores of this substance during even prolonged periods of inadequate dietary intake. There is little evidence that a lack of vitamins A, C, niacin, or riboflavin is an etiologic factor of the disease, and the authors conclude that the need for routine administration of these substances in peptic ulcer cases is doubtful. In any event the recommended daily doses of riboflavin (5 to 25 mgm) and niacin (100 to 150 mgm) are considerably more than can be utilized.

Pernicious Anemia and Susceptibility to Gastric Neoplasms. Henry S. Kaplan and Leo G. Rigler *J Lab Clin Med* 1947 31 444.

Statistically both cancer and adenomatous polyps of the stomach are reported associated with pernicious anemia more frequently than in normal patients. The average duration of pernicious anemia prior to the onset of cancer when it occurs is approximately 8.7 years. The apparent increase in gastric cancer morbidity in addition anemia is generally explained by the greatly increased life expectancy since the introduction of liver therapy. The incidence of cancer in patients with pernicious anemia is from 5 to 20 times that which would be expected on the basis of chance alone.

Gastric polyps are found at autopsy in the stomachs of patients with pernicious anemia 10 to 16 times more frequently than in other conditions. The nature of the etiologic relationship is not clear. Adequate anti-pernicious anemia therapy does not prevent the development of gastric carcinoma. Features common to pernicious anemia and gastric gastritis include achlorhydria and atrophic gastritis and hereditary gastritis does not seem to be a causative factor in pernicious anemia for these stomachs show no inflammatory changes. Likewise, pernicious anemia is not more common in the stomachs of cancerous individuals than in those of other individuals of comparable age. There is a high incidence of achlorhydria in relatives of patients with pernicious anemia and about 18 per cent of patients with pernicious anemia also have relatives with that disease. The fact that the gastric mucosa is a known storage site for the blood group-specific agglutinins suggests a further possible association with heredity. While observations to date are not statistically conclusive the present evidence suggests that the two diseases have common hereditary influences. The practical importance of these observations resolves into the early detection of gastric cancer which is the chief problem in stomach cancer today. The routine roentgenologic or gastroscopic exami-

nation of all patients in the gastric cancer bearing age (i.e. 40 years and over) would entail an enormous expenditure of time effort and money with a very small yield of tumors. Only 2 carcinomas were found in over 2,400 asymptomatic individuals past 50 years of age using a rapid fluoroscopic technique and none were found in 500 apparently healthy men over 45 years of age. Statistically about 3 individuals per 1,000 over 40 years of age are likely to have carcinoma of the stomach hence the necessity for selecting patients for routine periodic examinations of the stomach on the basis of some pre-existing disease or symptom with which the occurrence of gastric cancer can be shown to be associated. To date the only known indicator of this type is pernicious anemia. The authors present the results of serial roentgenologic and gastroscopic examinations in a series of patients based on this criterion.

Total number of patients with pernicious anemia examined	Carcinoma of stomach found	Adenoma polyps of stomach found	Total tumors of stomach found
259	18 (6.9%)	17 (6.6%)	35 (13.5%)

Patients with pernicious anemia must represent a very small fraction of those susceptible to gastric cancer. Series of patients with other indicators (achlorhydria, chronic gastritis, gall bladder disease and anemia) and relatives of patients with gastric cancer are being studied in an effort to find the criteria for mass surveys for the early detection of neoplasms of the stomach.

Pernicious Anemia and Tumors of the Stomach. Leo G. Rigler and Henry S. Kaplan *J Nat Cancer Inst* 1947 327.

Within the past 15 years increasing attention has been drawn to the coexistence of pernicious anemia and epithelial tumors of the stomach. That this association is more than accidental has been demonstrated by a number of large-scale statistical studies of postmortem cases and of living patients. The precise nature of this relationship is still far from clear. Three hypothetical possibilities are enumerated: (1) pernicious anemia is still far from cured; (2) gastric cancer directly produces gastric cancer; and (3) the two diseases are linked through a precursor or manifestations common to both. It has been suggested by Teufel that liver extract used so successfully in the treatment of pernicious anemia might contain a weak carcinogenic agent which, on successful administration, could lead to cancer in a susceptible individual. Recent experimental support of this startling suggestion warrants further study. According to these authors the best indicator of gastric cancer is pernicious anemia, while achlorhydria is considered the next best criterion. Routine roentgenograms may yield only a very small percentage of tumors if carried out on an unselected population over the age of 50. However, there is reason to expect that routine examination of symptomless individuals by means of roentgen rays

will result in the detection of gastric tumors in an early stage of development. Even rather large malignant neoplasms have been found in symptomless patients. Unfortunately patients with pernicious anemia represent a very small fraction of those susceptible to gastric cancer.

It seems desirable to effectuate a simple, rapid method for the routine roentgen examination of the stomach in symptomless individuals. Fluoroscopy alone results in a number of errors. The combination of fluoroscopy "spot" films, and a series of roentgenograms of the filled stomach is expensive and impractical on a very large scale. The possibility of utilizing some method of photofluorography or cine-roentgenography such as that advocated by De Castro should be seriously considered.

HAROLD LAUFMAN, M.D.

An Attempt to Identify Likely Precursors of Gastric Cancer. David State, Richard L. Varco, and Owen H. Wangensteen. *J. Nat. Cancer Inst.* 1947 7 379.

In 1945 a co-operative clinical study group was set up in the University Hospitals (Minnesota) embracing the Departments of Pathology, Radiology and Surgery in an attempt to define some of the likely precursors of gastric cancer. It was thought that persons with (1) achlorhydria, (2) gastric polyp, (3) pernicious anemia and (4) relatives of patients with proved gastric cancer would be more liable to develop carcinoma of the stomach than those who do not fall into these categories.

At the beginning of this study all male patients 55 years of age or older and female patients 65 years or older registering for the first time at the out patient clinic, were subjected to a gastric analysis employing 3 successive doses of 0.5 mgm. of histamine as a stimulant to gastric secretion. Those patients showing achlorhydria then had their stomachs examined gastroscopically and roentgenographically. If no gastric lesion was found, each achlorhydric patient was given a reappointment slip for a repeat examination in 6 months. After January 1, 1946 the age level for inclusion in the study was lowered for both female and male patients to 50 years or older. Also it became obvious that it would be profitable to study patients with histamine hypochlorhydria as well. Two hundred and thirty-eight patients were found to be achlorhydric to 3 successive doses of histamine, 67 were achlorhydric to 1 consecutive dose, and 45 were achlorhydric to 2 doses. An additional 30 patients were found to be hypochlorhydric (less than 20 degrees of free acid) after 3 successive doses of histamine. In these groups 4 unsuspected carcinomas of the stomach confirmed at operation, and 10 patients with gastric polyps were discovered. A third carcinoma of the stomach failed to be identified through a misinterpretation of the roentgenograms of the stomach.

Seventy nine patients with pernicious anemia were examined roentgenographically but no gastric carcinomas were found in this group.

Gastric carcinoma appears to occur more frequently in the relatives of patients with gastric carcinoma than in patients with noncancerous gall-bladder disease, hemorrhoids, hernia or rectal carcinoma, although these differences were not sufficiently great to be statistically significant. The unsatisfactory response of relatives to requests for an examination indicates that an active program of cancer education for the public is urgently needed. An additional 9 patients with gastric polyp obtained from the hospital records were placed under observation. Local excision of the polyp or gastric resection was done in 12 instances without discovering gastric cancer. Of 40 patients with occult blood in the stool, 20 suspected gastric cancer was found.

Studies such as this might well be undertaken on a large scale in many of the great medical centers of this country but would require large amounts of money and a spirit of co-operation on the part of the patients.

HAROLD LAUFMAN, M.D.

The Cytology of the Gastric Fluid in the Diagnosis of Carcinoma of the Stomach. George K. Papanicolaou and William A. Cooper. *J. Nat. Cancer Inst.* 1947 7 357.

For several years the authors have worked out a technique of diagnosing cancer through the recovery and identification of exfoliated neoplastic cells. This was first applied to the vaginal and uterine secretions for the diagnosis of cancer of the female genital tract. Later the work was extended to the examination of other fluids, such as urine, sputum, pleural and peritoneal exudates, and more recently the gastric secretion.

The specimens were obtained by emptying the fasting stomach with an ordinary Levine tube of whatever secretions it had accumulated. An equal volume of 95 per cent alcohol was immediately added to the aspirated specimen and this was sent to the laboratory. A detailed description is given regarding the handling and staining of these specimens.

The cytology of the gastric fluid is unique in that many of the cells are derived from other organs. Squamous cells of the esophageal or oral mucosa are sometimes found in the gastric fluid, as are cells foliated from the respiratory epithelium, the latter frequently being carried into the stomach by the swallowing of bronchial discharge. Normal cells of the gastric mucosa are of the columnar mucoid type and appear singly or in clusters. They are usually inconspicuous or totally absent and only rarely appear in large numbers.

The identification of cancer cells is facilitated by their abnormal traits, the most characteristic of which involve the nuclei. These are nuclear enlargement out of proportion to the size of the cells, mitotic activation, unequal fragmentation, hyperchromatism and large and atypical nucleoli. In adenocarcinoma the cells are more rounded and resemble adenocarcinoma cells from other organs. In mucoid carcinomas one finds many columnar forms in which the presence of mucin can be demonstrated.

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Although single cancer cells are often pathognomonic, a positive diagnosis should be based as much as possible on clusters which offer additional criteria such as crowding, irregularity of pattern, anisocytosis and anisonucleosis, engulfment and lack of definition of cell boundaries. In the clinical correlation of 137 cases there were 10 false negative 7 suspicious and 10 positive diagnoses in 27 cases of cancer. Three of the 10 cases that were missed proved to be scirrhus cancer. In this type of cancer desquamated cells are usually scanty or totally absent. As the authors have gained experience with the method they have learned to be cautious about recording specimens in which the cellular elements are degenerated and advise that such specimens be discarded entirely. Two cases of the 10 reported correct as definitely positive were of particular interest. One was a lesion of the cardia in which there were a gastric ulcer after x ray examination, at the operation and following gross pathological study. Only on microscopic study was a small cancer seen in one quadrant of the ulcer.

The authors emphasize the preliminary nature of this work and warn that there are many technical problems that remain to be studied. It is hoped that the accuracy of this method will improve with more experience.

The Radical Surgical Treatment of Gastric Cancer

George T. Pack. *J. Am. Cancer Inst.* 1947 7 337

It is pointed out that there is a great margin for error in reporting end-results for the treatment of gastric cancer, especially regarding the question of operability. The pronouncement by any surgeon of the inoperable state depends on (1) the condition of the patient; his age the coexistence of degenerative diseases and the complications attendant on the presence of the cancer (2) the extent of the disease i.e. the degree of involvement of the stomach and extension to and incorporation of neighboring viscera by the cancer and metastases to the regional and distal sites (3) the surgical philosophy moral point of view courage and experience of the surgeon.

With a knowledge of the inevitability of death from cancer of the stomach that is not treated, no surgeon would refuse a patient the slightest chance for cure or even relief because of the fear of criticism or an unnatural pride in low figures for operative mortality. Nor should any surgeon attempt to "play God" and decide arbitrarily that a certain patient with gastric cancer has lived a sufficiently long life or that he has so few remaining years of even normal life expectancy that operation at best would hardly be worth while. In the Gastric Service at Memorial Hospital in New York approximately 50 total gastrectomies have been performed for cancer of the stomach but of the adjacent lymph nodes bearing regions as well which include all the lymph nodes along the lesser and greater curvatures of the stomach the greater omentum in its entirety the para-

pyloric and retropyloric lymph nodes. In instances the peritoneum of the lesser omentum is stripped off with the specimen. The jejunal lumen is anastomosed to the esophagus either in front of the transverse colon. The anastomosis is fortified by suturing a flap of diaphragmatic peritoneum anteriorly and posteriorly below the anastomosis in order to suspend the jejunum and give additional strength to the anastomosis. A lateral anastomosis or enteroenterostomy is done in order to provide a short-circuiting of the bile and pancreatic juice between the proximal and distal jejunal limbs and in order to provide a suitable egress for any swallowed food which enters the proximal jejunal limb.

The operative mortality for total gastrectomy is 30 to 30 per cent as compared with 8 to 12 per cent for subtotal gastrectomy. The chief complications of the operation have been of pulmonary origin rather than infections in the peritoneal cavity. The author has found that the complication of severe anemia is not encountered so frequently as one might anticipate in view of the important role the stomach or duodenum plays in hematopoiesis.

The 8 to 10 per cent of patients with cancer involving the gastric cardia are no longer classified as incurable because the surgeon is now able to pursue an upward exposure of the cancer bearing segment to include the cardiac end of the stomach and the abdominal and thoracic esophagus so as to carry the resection high thereby insuring complete removal of the tumor and adjacent lymph nodes. A small exploratory upper left midrectus incision is made in order to ascertain the presence or absence of hepatic and peritoneal metastases. The extension of the cancer to regional lymph nodes the mobility of the cancer and the amount of distal uninvolved stomach findings warrant subsequent anastomosis. If exploratory incision is then extended upward through the costochondral cartilages and laterally in the seventh intercostal space to intercommunicate the thoracic and abdominal cavities.

The resection of cancers of the gastric cardia in the author's experience has increased to 58 per cent of the total number of patients subjected to laparotomy or thoracotomy.

Improvement in end results in the treatment of gastric cancer is attributable to a greater awareness on the part of the general public the improved facilities for the diagnosis of cancer the wider application of surgical resection by an increased number of surgeons who are performing the operations in numerous hospitals throughout the United States and finally by the introduction of extremely radical surgical procedures of 3 types (1) removal of the organs adjacent to the stomach that are involved by contiguous with the cancer (2) total gastrectomy when the cancer involves the major part of the stomach and (3) transthoracic transdiaphragmatic cardiectomy for cancers involving the gastric cardia. The total number of patients salvaged from those having the disease is inevitably increasing. A better appreciation

of proper preoperative and postoperative care and wider appreciation of the metabolic disorders coincident with and related to gastric cancer have also served to increase the salvage rate in the surgical treatment of this disease. HAROLD LAUFMAN MD

Gastric Operations. Robert M Zollinger and Stanley O Hoerr. *J Am Med Ass* 1947 134 575.

Few if any surgeons accept the fact that from 5 to 25 per cent of patients who have undergone gastric operations have symptoms related to the ingestion of food. The majority are inclined to call an operation successful only if there is no recurrence of the benign or malignant ulcer. Some of the symptoms reported either as mild or as severe and disabling attacks are sensations of warmth, sweating, dizziness, faintness, palpitation, nausea, and abdominal pain. It is believed that these symptoms are related to a carbohydrate-rich diet.

It has been suggested by Lapp and Dibold that the attacks are due to hypoglycemia occurring several hours after meals. It is believed that the condition represents an increased rate of sugar absorption due to more rapid delivery of sugar into the jejunum. Sugar taken well before the period of hypoglycemia, is advised.

Glaesner (1940) reported a condition of hyperglycemic shock characterized by nausea, vomiting, sunbar pains, visual disturbances, convulsions, and cardiac disturbances. He believed that the rapid absorption of sucrose, and not the delayed hypoglycemia, was responsible for the symptoms. The suggested treatment was small doses of insulin before meals in patients who exhibited these symptoms.

Custer and associates have described the "dumping syndrome" characterized by nausea and weakness, a feeling of warmth, cold diaphoresis of the face, and cardiac palpitation. The incidence of these symptoms in two groups subjected to gastric resection for benign ulcer was 5 and 12 per cent. They believe these symptoms are caused by sudden mechanical distention of the unprepared jejunum. The suggested preventive was an operation with a smaller gastrojejunal stoma. Ephedrine for slow gastric emptying, dilute hydrochloric acid and small feedings low in carbohydrate are suggested in the treatment of this syndrome.

Evenson studied gastric motility and dextrose tolerance curves in a group of controls (medically treated ulcer patients) and patients who had had a gastroenterostomy or resection. He found gastric motility is increased and emptying time decreased in patients with gastroenterostomy or resection. These patients also show an abnormal dextrose tolerance curve with a rapid and high primary rise and a rapid fall to low values. These curves are believed due to more rapid absorption, a consequence of more rapid gastric emptying.

The authors studied a series of 25 patients after gastric operations, and the majority of these patients had digestive complaints. The operative procedures were carried out for duodenal ulcer, gastric ulcer, and

gastric carcinoma. There were 21 men and 4 women whose ages ranged from 26 to 65. The time had elapsed varied and in some cases was over 10 years.

Ten of the patients showed both a hyperglycemic and hypoglycemic in one or more dextrose tolerance tests. 7 patients showed only hyperglycemia, and 4 showed hypoglycemia. Only 4 of the 25 showed neither hyper nor hypoglycemia.

Of the 25 patients with ulcer, 14 had some type of complaint during the course of the dextrose tolerance test. The complaint did not always coincide with the extremes of the blood sugar level. Ten of the 25 patients gave a history of postoperative discomfort of the type considered in this study. It was possible to correlate them with the blood sugar levels. In one group of patients the symptoms appeared shortly after eating and in the other group, after a brief period of an hour or longer.

Study of the protocols shows that abnormal absorption of sugar and outward symptoms do not depend on a direct connection between the stomach and jejunum. The condition may persist for many years. There is an unusually steep curve in a patient who has had a total gastrectomy. Individual susceptibility must play some part in the production of symptoms since steep curves with hyperglycemia did not always lead to symptoms. Other patients showed symptoms even though the blood sugar never rose to high levels. Blood sugar levels after meals high in fat and protein were only half those after meals high in carbohydrates. This indicates the value of eating small quantities of foods which are low in carbohydrate content.

The authors believe there are two distinct syndromes following gastric surgery—one appearing shortly after eating and one occurring after a latent period of an hour or more. They state that both syndromes may occur in the same individual. The later symptoms are due to hypoglycemia in most instances.

There is considerable disagreement as to the cause of these symptoms. Hyperglycemia and mechanical distention of the jejunum are not satisfactory explanations. There is considerable evidence favoring an abnormal carbohydrate absorption as being an important factor.

There are a number of contributing factors, such as (1) increased gastric motility (2) an abnormal rapid delivery of food into the jejunum, (3) failure of normal dilution of hypertonic solutions of sugar in the stomach, (4) an abnormally rapid absorption of sugar from the duodenum (5) possible effects of distention of the jejunum, and (6) the susceptibility of the individual.

Attack on any one of these factors may help in controlling symptoms. Therefore any attempt to slow gastric emptying will help. Perhaps it will be easier to provide smaller feedings with lower carbohydrate content to slow down the rate of sugar absorption and the possible irritative action on the jejunum.

It is believed that many patients who have submitted to gastric surgery can be benefited by regulation of their carbohydrate intake

ROBERT R. BROWNE M D

Surgery in Radiation Injury of the Stomach Ralph F Bowers and Irving B Brick. *Surgery* 1947 22 30

The authors present 6 cases of radiation effect on the stomach requiring surgical intervention. Similar cases have not been previously reported elsewhere. Perforation of radiation induced ulcers in the antral portion of the stomach was noted in 3 cases and hemorrhage was also noted in 3 cases. In 1 of which there was also a perforation. In the other case an uncomplicated ulcer at the pylorus was found. Radical surgery was required in chronically ill patients in whom the procedure is made additionally difficult because of the presence of radiation injury to the small intestine in some cases. The result of the gastric surgery has been satisfactory but complications incident to radiation injury in other parts of the gastrointestinal tract have appeared in some cases. It is emphasized that patients receiving similar amounts of radiation without apparent gastrointestinal injury have been observed, which accentuates the marked individual variability of response of the tissues of the gastrointestinal tract to radiation

JOHN J MALONEY M D

Total Gastrectomy Reginald H Smithwick. *J England J M*, 1947 237 39

A survey of the literature indicates a noteworthy recent decrease in operative mortality following total gastrectomy. Because of this it seems proper to utilize this operation somewhat more frequently particularly in cases in which a lesser procedure may jeopardize the chance for cure, because of an inadequate margin of safety beyond the gross limits of disease. Although the lower current operative mortality rate for total gastrectomy is undoubtedly due to a combination of factors, it is believed that improved surgical technique is one of the most important.

A closed (aseptic) method for esophagojejunostomy is described. This technique of anastomosis may further reduce the operative mortality by minimizing the hazard of peritonitis due to local contamination. The procedure is as satisfactory as open methods of suture, and has been found useful in all portions of the gastrointestinal tract.

The author presents a report of 2 cases in which the patients are living and well 5 years and 2 months, and 10½ years respectively following total gastrectomy for carcinoma. The latter appears to be the longest recorded survival after total gastrectomy for carcinoma.

STUART KATZ M D

Total Gastrectomy Henry K. Ransom. *Arch Surg* 1947 55:13

By total gastrectomy is meant the removal of the entire stomach with a cuff of the esophagus above and of the duodenum below. With the many advances

in preoperative and postoperative care and the better anesthetic methods there has resulted a reduction of the operative mortality. While this mortality is still disturbingly high it is not prohibitive. In addition it can now be stated that a person can live a reasonably comfortable life without a stomach.

The author reports a series of 60 cases of total gastrectomy over a 9 year period. The oldest patient was 81 and the youngest 30. There were 14 deaths, or an operative mortality of 23.3 per cent. General peritonitis was the most common cause of death and was usually due to leakage at the site of the esophagojejunal anastomosis. Of the 46 patients who survived the operation, 31 have subsequently died. In all instances death was due to recurrence of the malignant disease. The average duration of life in this group was 50 months. Eleven patients are still living after operation for carcinoma. Approximately one half of these were operated on too recently for evaluation of the result. Three patients may be classified as representing 5 year cures.

All of the patients with benign lesions who survived operation are living and maintain a satisfactory state of nutrition. In 2 patients the classic picture of pernicious anemia developed approximately 5 years after operation.

The technical details of the operation are discussed and the value of the procedure is considered.

HARRY W FINE M D

Two Hundred and Fifty Four Pathologic Specimens Obtained by Gastric Resection. Study of the Lesional Types, Topography and Histopathology (254 Piezas de resección gástrica. Estudio de la frecuencia de los tipos lesionales. topografía de las lesiones e histopatología) H Lorenzo, Lozada, and Br Séliska Piovano. *Arch surg med* 1947 30 64.

The authors studied 254 surgical specimens obtained by gastrectomy. Of these 173 were ulcers, 111 gastric and 62 duodenal. According to the authors the differentiation between ulcerated cancer and a benign ulcer which has become neoplastic is based on the fact that benign ulcers which undergo carcinomatous degeneration show a destruction of the muscular coat of the stomach whereas ulcerated carcinomas do not.

Using this criterion the authors found that 59 of 254 were primary carcinomas and that 79.66 per cent of these occurred in males. Of 111 gastric ulcers, 17 (15.3%) became cancerous. 13 of these occurred in men and 6 in women.

The article is illustrated by several interesting histological sections and pictures of gross specimens.

WILLIAM E. RICKETTS, M D

Anatomic Variations of the Vagus Nerves—Their Significance in Vagus Neurectomy J Allen Chamberlin and Theodore Winship. *Surgery* 1947 22 1

The authors' article is based on studies of 30 esophagi removed at autopsy. The specimens in

cluding the lower trachea, main stem bronchi, and a portion or all of the stomach in as many cases as possible. A few specimens obtained early in the course of the work were studied and dissected in the fresh state, but it was later considered advisable to complete the studies on fixed specimens inasmuch as more accurate evaluation of all fibers could thereby be made. The ages of the patients from whom specimens were removed ranged from 5 to 80 years and the ratio of males to females was approximately equal. Body sizes were, of course, variably represented and there was no apparent relationship between body sizes and the sizes and character of the nerves. The course of the vagi from the level of the primary bronchi to the stomach was studied, the general structure of the so-called esophageal plexuses was noted, and the general relationship of the nerves to the stomach was examined in a number of specimens, but special emphasis was placed on the study of variations in appearance, formation, and distribution of the gastric divisions of the vagi which form the anterior and posterior esophageal plexuses and course to the stomach through the esophageal hiatus.

For purposes of simplification a classification was decided upon which would enable the authors to place the specimens studied into classes based on certain major anatomic variations of the gastric divisions of the vagus nerves at the supradiaphragmatic levels. The classification is as follows:

1. Simple or basic pattern, in which a single, primary trunk forms from the anterior and posterior esophageal plexuses, forming thereby the so-called left, or anterior and the right or posterior nerves and entering the hiatus as single trunks. The classification of the specimens is based on the general character of the nerve or nerve complex between the levels of the esophageal plexus and the upper level of the diaphragm.

2. Intermediate pattern, in which a single primary trunk forms from the anterior or the posterior esophageal plexuses or both but divides into two or more secondary nerve trunks before entering the hiatus in their course to the stomach.

3. Complex pattern, in which two or more primary trunks form from the anterior and/or the posterior esophageal plexus or plexuses before entering the esophageal hiatus in their course to the stomach regardless of the number or character of the secondary nerve trunks.

From the analysis of the material, it can be concluded that a distinct majority of the gastric divisions of the vagi are of a simple pattern, with a single trunk representing the left, or anterior nerve and a single trunk representing the right, or posterior nerve. In this series, 30 specimens, or 60 per cent, were placed in this classification. Relatively few specimens fell into the intermediate classification. Eight specimens, or 16 per cent, were of this pattern, in which single trunks were formed from the anterior or the posterior esophageal plexuses, or both but presented two or more secondary trunks which formed from the primary trunk before entering the

esophageal hiatus. Twelve or 24 per cent, of the specimens were of the complex pattern, in which there was more than one primary trunk formed from the anterior or the posterior esophageal plexuses or both. These figures suggest that a distinct majority of the cases encountered should present single posterior nerves which lack an immediately supradiaphragmatic complex and consequently present no technical difficulty in accomplishing a complete bilateral vagus neurectomy. The few intermediate types which one encounters should involve somewhat greater technical difficulty in that the operator should attempt to locate the primary trunk of the complex, and division should be made at this point. If this is not done and division is attempted above or below this level one becomes involved in the fibers which make up a part of the complex esophageal plexus or in the multiple secondary trunks which enter the hiatus. One is thus confronted with the potential danger of incomplete division of all the fibers courting to the stomach. Inasmuch as the pattern does not occur in great numbers and must be chosen with care in choosing the proper level for division complete neurectomy should be accomplished, as need have little fear of operative failure. However, recognition of the fact that this pattern does occasionally occur is important. The fact that 12, or 24 per cent, of the specimens were of the complex pattern should be taken seriously; a knowledge of these anatomic variations is essential and the clinical importance of the occurrence of these multiple primary trunk patterns should be recognized.

As has been previously indicated, the most common location of the gastric nerves or nerve complexes has been found to be within an area just above the diaphragm between the anterior midline and a point just anterior and medial to the true left lateral position for the left nerve, and between the posterior midline and a point just posterior and medial to the true right lateral position for the right nerve. These positions have been designated as normal and fibers of the gastric divisions of the vagi which have been found located outside of these areas have been designated as abnormal in position. Of the anterior nerves or nerve complexes examined, 44, or 88 per cent, were found in the so-called normal position and only 6 or 12 per cent of the specimens were in abnormal positions. Of the posterior nerves or nerve complexes 41 or 82 per cent, were in normal position and 9, or 18 per cent, were in abnormal positions. Of the posterior nerves, 3 specimens presented complexes which were in normal position, but each with a single fiber which was in an abnormal position. It is gratifying to note that the anterior and posterior gastric nerves usually are found within fairly limited areas. However, since there are occasional variations in their locations and since there are rather marked differences in the sizes of the nerves, some of which are quite obscure one must recognize the fact that some fibers may be overlooked at the time of vagotomy and an incomplete division results.

As far as the gross morphology of the nerve fibers is concerned 92 or 73 per cent were oval in shape and 34 or 37 per cent were flat, or ribbonlike. None of the nerves appeared as round fibers. Many of these would be difficult to palpate and a few of indicated later in the discussion of the number and percentage of obscure fibers noted in the series.

Of the fibers examined 88 or 70 per cent were considered distinctly prominent and should have been easily palpated and visualized at operation. 21 or 16 per cent were moderately prominent but should have been easily demonstrable. 17 or 14 per cent were considered obscure and would have had to be sought for meticulously at the time of vagotomy.

The more complicated patterns occur in sufficiently great numbers to justify serious consideration of the best methods of performing the vagus neurectomy in order to be more certain of complete division of all fibers. When the operator is certain that complete division is possible if the primary gastric nerve trunks are divided, one would feel that this is the procedure of choice. However, if there is doubt, particularly when the pattern is very complex, it would seem that the procedure of choice would be in effect a "stripping" of the vagus fibers from the level of the hilum to the gastric fundus. Further in view of the varied patterns and distribution of the gastric divisions of the vagus nerves, one would be led seriously to question the use of the abdominal approach as a routine procedure for vagotomy. For the surgeon who is only occasionally performing vagotomy this would seem particularly to apply.

JOHN J. MALONEY, M.D.

Intestinal Obstruction: Analysis of 352 Cases.
W. Hendricks and W. D. Griffin. *Surg. Clin. N. America*, 1947, 27, 51.

Intestinal obstruction is a most hazardous diagnostic problem because there are no absolute criteria to differentiate between simple and strangulating obstructions. The authors present an analysis of 352 cases of bowel obstruction (exclusive of 138 cases of incarcerated and strangulated external hernias). There were 168 cases of obstruction of the small bowel and 184 cases of obstruction of the large bowel.

Of the small bowel obstructions adhesions were considered the etiologic agent in 58 per cent of the cases. Pain, vomiting, and distention were the outstanding symptoms being present in 80 per cent of the cases. A scout x-ray film of the abdomen (supine position) was diagnostic of obstruction in 65 per cent of the cases and a great aid in determination of the type and the location of the obstruction. Visible gas in distended loops of small bowel is considered absolutely diagnostic of stasis of the intestinal contents.

Early diagnosis and early surgical decompression in obstruction of the small bowel have been emphasized. Enterostomy was necessary in only 3 cases.

In 98 per cent of the cases the cause of the obstruction was corrected directly. Resection was necessary in 34 per cent of the cases. In most of these the anastomosis was performed by an open end-to-end anastomosis with interrupted sutures throughout. An overall mortality of 27.9 per cent is reported in the cases of small bowel obstruction.

In 60 per cent of the patients with large bowel obstruction the condition was due to carcinoma. The left side of the colon was involved in 81 per cent and the right side in 19 per cent of the patients. Volvulus of the sigmoid is discussed as a separate clinical entity. The value of x-ray diagnosis is emphasized by the authors. All of the patients with volvulus were treated by exteriorization and second stage resection. A mortality rate of 20.5 per cent is reported for all obstructions of the large bowel.

EDWARD F. LEWISON, M.D.

Studies on Experimentally Provoked Ileus with Reference to Inhalational Therapy.
Troell. *Acta chir. scand* 1947, 95, Supp. 133.

This experimental study of the diffusion of gases was predicated upon the clinical use of from 95 to 100 per cent oxygen inhalation in the treatment of ileus as worked out by Fine *et al.* in 1935 and upon the known toxic effects of oxygen when inhaled in high concentrations for a prolonged period of time. To avoid the toxic effect of the oxygen and at the same time procure the same beneficial effect upon the ileus helium in a mixture with oxygen was tested as an inhalant under varying circumstances. The effect of increased carbon dioxide concentration in the inhaled gas and of increased atmospheric pressure was also tested. In the second section of the experiment the known toxic effects of oxygen were reviewed and experiments were described which tested the effect of oxygen poisoning upon intestinal motility.

Intestinal gas diffusion was studied in experimentally provoked ileus in a series of rabbits. A quantity of 80 milliliters of nitrogen or helium was injected in closed intestinal loops of definite lengths and then the animals were placed in a 30 liter pressure chamber. Following a definite scheme the animals were allowed to breathe partly pure oxygen partly oxygen mixed with carbon dioxide, nitrogen, and helium in different concentrations and at 1 and 2 atmospheres of pressure. Three atmospheres of pressure were not used because the toxic effect of oxygen increases beyond reasonable clinical value at that pressure. On conclusion of the treatment the gas remaining in the intestinal loop was measured and its composition determined. The average was calculated in each series to determine the reduction in the total gas volume and also the reduction in the total gas specific gas injected into the loop of bowel.

The inhalation of 60 per cent oxygen and 40 per cent helium for 3 hours followed by the inhalation of 100 per cent oxygen and then of air for 1 hour each reduced the total volume of gas enclosed in the intestine slightly more than the inhalation of 100 per cent oxygen for 3 hours followed by the inhalation of

air for an hour. The diffusion of the helium injected at the beginning of the experiment increased by 5 per cent at the same time.

A carbon dioxide concentration of from 5 to 15 per cent in the inhalation gas increased the gas diffusion from the intestine approximately 6 per cent. An excess pressure of 2 atmospheres bringing the total pressure to 3 atmospheres increased the gas diffusion from the intestine by approximately 6 per cent as compared with similar inhalations at 2 atmospheres total pressure. When an increased carbon dioxide concentration in the inhaled gas was coupled with a pressure of 3 atmospheres, the gas diffusion from the intestine for a 4 hour period was increased by 12 to 13 per cent.

The toxic effect of oxygen on intestinal motility in vivo was studied in rabbits with the help of the abdominal window. As in the first part of the experiment, the animals were placed in the pressure chamber and allowed to breathe pure oxygen and oxygen mixed with carbon dioxide at 1 and 3 atmospheres of pressure according to a definite scheme. The rabbits were anesthetized with urethane during the experiment and a mirror placed in the chamber to observe the intestinal motility.

Continuous breathing of 100 per cent oxygen at 1 atmosphere of pressure produced slight to strong inhibition of motility in about 50 per cent of the cases in 4 to 5 hours, and no inhibition in other cases. At 3 atmospheres of pressure, 100 per cent oxygen produced moderate inhibition in all cases after 3 hours and almost complete inhibition in 6 hours. A partial pressure of from 4 to 8 per cent carbon dioxide had no effect upon the intestinal motility. The motility returned to normal following the oxygen inhalation in from 10 minutes to 3 hours when the rabbit was allowed to breathe air. The experiment indicated that inhibition of intestinal motility is a sign of oxygen poisoning.

The author feels that the results of the experiments support the opinion that 100 per cent oxygen treatment has an unsatisfactory effect upon the organism and that in cases of flous inhalation therapy with 100 per cent oxygen should be replaced by a combination method alternating 100 per cent oxygen with 60 per cent oxygen in helium. A carbon dioxide concentration of a low percentage has a favorable effect upon diffusion of gas from the intestine. When 3 atmospheres of pressure are used diffusion of gas from the intestine will be increased when 100 per cent oxygen is used as the inhalant.

In the treatment of flous the outlined therapy is of most value when treatment is instituted early and intraductal suction should be used simultaneously.

FREDERICK C. HOGGREN, M.D.

Chemical Investigation of Enteroliths in Greville's Case and the Report of a Further Case of Primary Calculus of the Small Intestine. Gunnar Bliz. *Acta. chir. scand.* 947 95 4 1

The author carried out a chemical analysis of the enterolith in a case reported by Greville. It was

found to consist of 70 per cent choleic acid, 6.6 per cent water, 3 per cent calcium oxalate, 1.6 per cent of fatty acids and cholesterol, 1.8 per cent ash (calcium and phosphate) and 10 per cent of bile pigments. Traces of iron and magnesium but no zinc, was present.

The author was sent a small intestinal calcareous diverticulum resected by Dr. J. Waldenström. The stone (weight 4 gm.) had a smooth, brownish-black surface layer 1 mm thick, with an interior of light brown. The center and the surface were analyzed separately. The interior was composed of calcium oxalate (56%), choleic acid (10%), fatty acid (8%), cholesterol (8%), water (3.6%), zinc sulphide (0.6%), the rest was composed of bilirubin calcium. The surface was composed of 70 per cent calcium oxalate, 4.6 per cent water, 4 per cent of substances soluble in organic solvents (fatty acids, cholesterol, choleic acid) the remainder being bilirubin calcium. No carbonate, magnesium phosphate or zinc was found, and only traces of phosphate were present in the stone.

In many ways this concretion had a similar chemical composition to that of the calculus previously reported by the author in 1935.

ROBERT K. BRIDLOW, M.D.

Benign Tumors of the Small Intestine (Finnish). *benign del. tenae*. T. Castrén. *Acta. Paediatrica, sc.* 1947 54 80.

The author presents 3 cases of benign tumors of the small bowel with a review of the literature. The first case presented symptoms of intestinal hemorrhage. The clinical diagnosis was that of duodenal ulcer with x-ray corroboration. At operation, the patient was found to have a deformed duodenal bulb, retracted and fixed so as to make resection impossible. A small tumor was also palpable about 10 cm. from the duodenojejunal angle. A posterior gastrotomy was performed with resection of about 5 cm. of small bowel and end-to-end anastomosis. The histological diagnosis was that of leiomyoma and because of its vascularity it was the author's opinion that the tumor was the source of the hemorrhage rather than the duodenal ulcer.

The other 2 cases were fibromas and both presented clinical pictures of obstruction. The first patient had repeated attacks and was operated on with lysis of adhesion. The author points out the danger of operating after repeated attacks before the patient has fully recovered from previous attacks. The second patient made an uneventful recovery. Both patients were found to have invagination of the bowel (intussusception) at operation. In the first case an end-to-end anastomosis was performed with resection of 30 cm. of bowel because of questionable vitality. The tumor was about the size of a pigeon's egg, and was located about 35 cm. from the ileocecal valve. The second case presented a fibroma, one the size of a small mandarin and the other the size of a large nut. About 1 meter of small bowel was resected and the

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tumors were located about 60 cm from the ligament of Treitz.

The author stresses the importance of keeping in mind the possibility that tumors may be the cause of small bowel obstruction when no other cause is apparent. He cites case reports in the literature in which the tumors were missed and the patients had to be operated on repeatedly. The possibility of repeated adenoma formation is mentioned and the case of Collier (*Med J Australia* 1927) is cited in which the patient with symptoms of bowel obstruction was operated on 3 times for adenoma of the small bowel and each time a tumor was found in a different part of the small intestine.

Use and Abuse of Intestinal Decompression Tube
A Study Based upon 288 Cases M O Cantor
A S Kennedy and R P Reynolds *Am J Surg.* 1947 73 437

The authors by means of a single lumen long intestinal decompression tube with a mercury balloon tip (the Cantor tube) have used intubation successfully in 96 per cent of 200 cases of intestinal distention. Technical emphasis is placed on understanding the mechanism of the tube. The propulsive mechanism is the head of the long intestinal tube which is a balloon tip filled with mercury. Should extravasation of mercury accidentally occur it is completely innocuous.

The only cases in which intestinal intubation alone can be safely used are those of adynamic obstruction or of inflammatory ileus.

All patients with mechanical ileus must be operated upon and intubation used as an adjunct prior to surgery. The use of the Cantor tube is recommended as a preliminary to bowel resection and the pa-

Intestinal intubation obviates the necessity for enterostomy and hence reduces the risk to the patient. It is suggested by the authors that the intestinal decompression tube is merely an instrument and that it must be used as such by the surgeon and not relegated to the intern or nurse. In the hands of a novice it may be harmful and dangerous.

The technique employed in successfully passing the Cantor tube is very carefully described and should prove helpful in mastering the simple tricks which have trapped so many surgeons so often.

Edward F Lennox 31 D
Nondrainage and Early Ambulation in Cases of Perforative Appendicitis Arnold S Jackson
Surgery 1947 34 644

The author presents 15 cases of perforative appendicitis with peritonitis or abscess formation in which the appendix was removed. Sulfathiazole was used intraperitoneally, closure without drainage was done and early ambulation encouraged. One case of secondary abscess required drainage. Otherwise there were no complications or deaths. From these instances the author concludes that nondrainage in cases of perforative appendicitis with

peritonitis is preferable to drainage. Such a procedure eliminates prolonged drainage and wound infection and minimizes the hazards of postoperative hernia, fistula, adhesions, etc. He advocates spinal anesthesia and early ambulation.

C. FREDERICK KITTLE, M D

Volvulus of the Cecum and Ascending Colon
Edward L. Young, Harvey R. Morrison and Walter E. Wilson Jr *N England J M* 1947 337 78.

The authors reported 7 cases of volvulus of the cecum and ascending colon which is of uncommon occurrence. Six patients were in the middle or elderly age groups. 2 patients had had more than one previous attack. 4 patients expelled flatus or other movements in spite of the volvulus at operation the cecum was frequently located in the left upper quadrant of the abdomen. The only death followed a resection and primary ileotransverse colostomy. These observations are in accord with those reported in the literature.

Volvulus of the cecum may be a congenital subacute or recurring. There is always a congenital lack of fixation of the cecum with a point of attachment below which the bowel rotates. In over 50 per cent of cases the cecum is mobile enough to allow the development of a volvulus and free enough to allow twisting are violent peristaltic forces that may produce torsion. The extraneous factors that may produce gastric or overeating abdominal tumors, mesenteric cysts, fecaliths, foreign bodies, direct violence, purulent constipation, acute appendicitis and pregnancy.

Although the correct diagnosis of acute volvulus of the cecum is usually not made before operation the authors believe that by careful roentgenologic study and a thorough review of the history and physical findings the diagnosis could be made oftener. The history is one of acute intestinal obstruction. In half of the cases there is a history of an antecedent colicky pain in the right lower quadrant of the abdomen with nausea and vomiting. The cardinal physical findings are distention, generalized tenderness and spasm of the abdominal muscles. Peristalsis is absent in the late cases. The pertinent roentgenologic points are dilatation of the cecum with variable lengths of the ascending colon and terminal ileum an abnormal position of the dilated cecum (in the left upper quadrant in 50 per cent of the cases), with absence of a normal cecal outline in its normal anatomic location and demonstration by barium enema of the twisting and torsion of the mucosal pattern at the point of lumen arrest characteristic of volvulus.

The treatment of acute cecal volvulus is early surgery because the longer the blood supply has been compromised the more radical the necessary surgery must be. The volvulus must be reduced, the obstruction must be relieved and recurrence prevented. The various surgical forms of therapy are (1) detorsion and resection resulting in cecal fixation to the anterior abdominal wall and decompression of the

bowel and (2) detorsion and resection of the cecum and ascending colon. If the viability of the cecum is in doubt resection of the cecum and ascending colon according to the Mikulicz technique and exteriorization should be performed. Postoperatively proper fluid and electrolyte balance and adequate nutrition should be maintained.

ROBERT TOWELL, M.D.

Wounds of the Colon and Rectum. J. E. Flynn
Am J Surg 1947 73 450.

The author discusses the high mortality and seriousness of wounds of the large intestine and rectum as evidenced by mortality statistics in World War I. Because of the better nutritional state of American soldiers in World War II the generous use of blood and plasma transfusions, chemotherapy and the benefits of early surgery it is suggested that death rates due to large bowel wounds will be considerably lower in the final reckoning of World War II.

Types of injury to the rectum and large bowel are described and the character of lesions in different parts of the colon are discussed and illustrated by case reports.

Experience in World War II has repeatedly demonstrated the wisdom of treating wounds of the colon by exteriorization whenever possible. If primary closure is ever performed then a proximal colostomy is to be an adjunct procedure. Resection is rarely indicated in wounds of the large bowel.

When a colostomy is performed the two ends of the bowel should be completely transected and both ends of the bowel brought out on the abdominal wall at different sites. This procedure prevents spillage of fecal material into the distal loop, prevents intestinal obstruction, prevents interposition of a loop of small bowel in a septum and permits an easier end-to-end anastomosis in final closure.

A Mikulicz colostomy was commonly used by front line surgeons during the early part of the war. In most of these cases it was found feasible by the author to close the spur by a crushing technique. However in 20 per cent it was found necessary to perform an intraperitoneal end-to-end anastomosis. The author suggests the advantages to be gained by a Devine type colostomy.

The problem of edema of the colostomy stoma or exteriorized wounded segment of large bowel is discussed and satisfactory treatment by pressure is described.

The very important point of not making a colostomy stoma through the exploratory laparotomy incision because of sepsis and dehiscence is emphasized.

The special problem of rectal wounds and their treatment by nonsuture but proximal colostomy is presented. The period of waiting for spontaneous wound closure, as proved by x rays and proctoscopy before colostomy closure is most important, particularly in the definitive stage of surgical repair. Skillful surgery at advance installations was one of the real advances in World War II.

EDWARD F. LEWIS, M.D.

Perforations from Proctoscopy. Albert F. R. Kahn
Gastroenterology 1947 9 32.

Of 340 questionnaires a king for reports of cecal perforation as a result of proctoscopy which were sent out to every member of the American Gastroenterological Association and the American Proctologic Society 215 answers were received. One hundred and thirty-eight members replied that they had encountered no perforations. 45 reported 1 perforation from other causes than proctoscopy, 34 reported 46 cases of perforation due to proctoscopy. In addition 48 cases of proctoscopic perforation were collected from the literature.

The serious nature of the injury is evident. Of total of 94 cases of proctoscopic perforation of the rectum or sigmoid there were 45 deaths—a mortality of 47 per cent.

Early diagnosis is important, and immediate operation is indicated. The mortality of cases in which the perforation was recognized at once and in which immediate operation took place was 8 per cent. Operation in the period of 3 to 6 hours after perforation bore a mortality of 50 per cent and in the 6 to 12 hour period there was a death rate of 75 per cent. Shock and sudden severe abdominal pain are characteristic diagnostic points when they occur. In these symptoms were seen in less than half the cases. In the majority of instances the perforation was recognized at proctoscopy when the instrument was suddenly felt to pass "higher than usual," or when bowel rent, fat peritoneum or abdominal contents were visualized through the proctoscope. Signs of peritoneal irritation may occur immediately but frequently these are delayed until the development of a true peritonitis. The roentgenologic finding of gas under the right diaphragm is pathognomonic of perforation of a hollow viscus, and may be required for an adequate diagnosis. A rising leucocyte count and a rapidly increasing sedimentation rate are constant findings.

The authors conclude that although proctoscopy is a valuable diagnostic aid it is not unattended by danger and should not be performed by those who have not adequate training in the technique. At all times the instrument should be passed under direct visual guidance, and where this last is not possible owing to persistent angulations of the bowel, fecal accumulations, bloody or other discharge, the presence of new growths, or to the struggles of a nervous, unco-operative patient, the examination should be immediately terminated.

Comprehensive statistics showing the reason for examination, the cause of perforation, concomitant disease and the type of operation performed, as well as suggestions for preoperative and postoperative care are included.

WAYNE CAMBROW, M.D.

Right-Sided Colitis. Burrill B. Crohn, John H. Garlock, and Harry Yarnis. *J Am Med Ass* 1947 34 334.

The colon on the right side is the site of nonspecific ulcerative colitis in 8 per cent of the cases of this

condition. The condition cannot be diagnosed by sigmoidoscopic examination. Later in the disease there may be a patchy or continuous extension to the remainder of the colon. In contrast to colitis on the left side, there are less of the classical symptoms such as diarrhea, urgency, and bloody stools, but more constitutional manifestations such as fever, joint pains, ocular complications, and involvement of the heart.

The authors have studied 77 cases of colitis on the right side. No specific organisms have been implicated. The average age of the patients has been 27.3 years; the youngest being 6 and the oldest 60. There were 45 women and 32 men.

The authors observed that while the rectum and anus were not involved by the inflammatory process, perirectal abscesses and fistulas were present. The assumption is that the infectious agent is carried from the right colon to the crypts of Morgagni and leads to infection, abscesses, and fistulas.

Forty nine of 77 cases showed fevers ranging from 101 to 105 degrees. The leucocyte count was usually low or only slightly elevated (8,000 to 15,000). Diarrhea was minimal. One or more joints were the site of periarthritic inflammation. Phlyctenular conjunctivitis, iritis, keratitis, and uveitis were not common but did occur.

Medical management consists of 350 c.c. retention enemas of a 1 to 4000 solution of neutral acriflavine in saline solution daily. Insoluble sulfonamides in doses of 0.55 gm. per kilogram of body weight daily and intramuscular injections of crude liver extract and vitamin B complex.

On the basis of their experiences the authors believe that most of the patients will require surgery. In many cases the disease progresses from right to left and eventually involves the rectum.

When there is evidence of involvement of the sigmoid or rectum, the first operation should consist of ileostomy followed from 3 to 6 months later by subtotal colectomy. After the seriously diseased colon is removed, the rectum returns to normal and it is possible to reconnect the ileum and the upper part of the rectum.

When the rectum and sigmoid are not involved the first operation is carried out through a left rectus incision. The terminal part of the ileum is divided about 8 inches from the cecum after section of its mesentery and accurate ligation of the vascular arches. The proximal loop should be well mobilized so that it can be anastomosed to the rectum deep in the pelvis if necessary. Both ends of the ileum are simply inverted with silk and the distal one is dropped into the abdomen.

The colon and mesocolon are divided at a healthy point. The proximal part of the colon is brought out through the abdominal wall for externalization to allow for external drainage of the foul discharge that comes from the diseased segment. The distal end of the colon is now inverted with three layers of silk. The proximal ileac loop and distal colon are connected by a side to side anastomosis.

The second operation, which is a subtotal colectomy is done through a right rectus incision when the patient has sufficiently recovered.

DANIEL RUOZ, M.D.

The Importance of Malignant Degeneration as a Complication of Chronic Ulcerative Colitis.
Richard B. Catroff and Earl J. Boehme. *Gastroenterology* 1947 8: 695

In the present article, the importance of malignant degeneration as a complication of chronic ulcerative colitis is emphasized. The authors review approximately 75 cases from the literature. Nine additional cases are reported. Carcinoma arising from ulcerative colitis is highly malignant and metastasizes early. Few patients have had resections and only an occasional one has survived as long as 5 years. All patients with long-standing ulcerative colitis should be examined at frequent intervals as a means of early discovery of malignant disease. This offers the only hope of improving the present unfavorable results.

The comparatively few cases of carcinoma complicating ulcerative colitis (approximately 75) appearing in the literature do not give a true picture of the prevalence of this complication. There are several reasons for this: the chief of which is that long follow-up studies must be made.

In the present series the average duration from the onset of ulcerative colitis until the development of the cancer was over 9 years. In a series of 54 cases reported by Bergen and Sauer it was 17.6 years. During such a long interval many cases are not traceable. It is also probable that some patients die of carcinoma when the ulcerative colitis is in complete remission, and the death is not associated with the previous ulcerative colitis or death is assumed to have occurred as the result of reactivation of the colitis. Other follow-up studies are of insufficient duration to be significant. A second factor in this apparent paucity of cases may be that in most cases the patients are not operated on. In some of the cases reported the cancers have been found during colectomy and if the indications for resection were broadened the incidence of carcinoma discovered might well be increased. In addition it is probable that some of the patients who died with ulcerative colitis, without autopsy had malignancy as the cause of death. Finally a careful pathologic study should be made of colons removed at operation or autopsy. Many of the lesions are small, and if there is extensive polyps or pseudopolyps, careful search may reveal lesions in the bowel wall or in the polyps.

Ulcerative colitis developing in children should be watched with great care since in them the incidence of cancer is so high. Early colectomy might prevent some of the deaths in these cases. The rectum and sigmoid should be inspected periodically in all cases of long-standing ulcerative colitis in which an indication for colectomy has not arisen. Any colon defunctionalized by ileostomy should be studied by

barium enema periodically to rule out malignancy in the part of the colon not visualized by sigmoidoscopy. It is also evident that in the so-called cured cases of ulcerative colitis a periodic roentgenographic and sigmoidoscopic study of the patient's colon should be made throughout life.

CHARLES BARON, MD

Cancer of the Colon and a Detail of Operative Technique. Rudolf Brandberg and Tore Ekblom. *Acta. chir. scand.* 1947 95: 461.

The literature indicates a 'palpable' improvement in the results of the treatment of cancer of the colon during the past decade. There has been a numerical increase in operable cases and a reduction in operative mortality.

No such progress has been made among the 107 patients with colonic cancer hospitalized from 1940 to 1946 in the authors' care (nor indeed in Sweden). This is due largely to the condition in which the authors' patients were received: 29 had acute ileus, 33 had chronic obstruction, and the average age was high, 70 per cent of the patients being over 60 years and 30 per cent over 70 years of age.

Some type of resection was carried out in 63 cases—an operability rate of 59 per cent. Ochsner and DeBakey's series of 4,561 cases had an operability rate of 58.5 per cent. (In Zininger's series [1943] among private patients the operability rate was 91 per cent among charity patients, 52 per cent.)

In the authors' cases, the primary mortality was 13 per cent. The total death rate following resections for tumors on the right was 19 per cent and for tumors on the left, 10 per cent. This is the reverse of the usually reported higher mortality for left-sided tumor resections. (Ochsner and DeBakey [1939] give mortality rates of 10.6 per cent for right-sided and 24.4 per cent for left-sided tumors with a total mortality of 31.7 per cent.)

The author's follow-up studies on various types of resection yield no conclusive evidence in favor of any individual procedure.

FRANK B. QUEEN, MD

The Surgical Treatment of Cancer of the Rectum and of the Sigmoid. (Tratamiento quirúrgico del cáncer del recto y sigmoides.) J. Iglesias de la Torre and E. Figuera Campos. *Rev. med. cubana* 1946, Vol. 57.

The authors recommend abdominal perineal resection in one stage as the elective surgical treatment of rectosigmoid cancer. The invasion of this type of tumor is discussed and the symptoms which should lead to the early diagnosis of this lesion are enumerated. Distal rectal examination and rectosigmoidoscopy including the biopsy of lesions are considered of major importance in the early detection of these tumors. The formation of an ileac anus is considered the elective procedure, the perineal colostomy being a more difficult procedure and leading to subsequent stenosis of the bowel.

In cases of cancer of the rectosigmoid with intestinal obstruction the Devine colostomy is advised.

Wide resections are advised including the rectum, the anus and its sphincter, the levator ani muscles, the ischio-rectal fat, the mesosigmoid, and the pelvic peritoneum. Catheterization of the ureters is considered imperative. The authors emphasize the importance of suturing the free mesosigmoid to the colostomy to the lateral wall of the abdomen to avoid herniation. The Sims position for the postoperative stage is considered elective.

WILLIAM E. RICEHILL, MD

Resection of the Rectum and Rectosigmoid with Primary Extraperitoneal End-to-End Open Anastomosis. Carleton Mathewson, Jr. and Victor Richards. *West J. Surg.* 1947 57: 67.

For more than a century surgeons have prepared various procedures for preserving the sphincter anismus following resection of carcinoma of the rectum and rectosigmoid. Because of the high mortality and morbidity associated with the earlier attempts because of the fear of local recurrence most of these methods were abandoned in favor of abdominal local resection. Newer studies on lymphatic spread together with our present knowledge of the means of controlling infection following intestinal surgery, have led to renewed efforts on the part of many surgeons to avoid permanent colostomy. The safety and adequacy of procedures directed toward restoration of the normal course and control of intestinal erosion have recently been made evident.

Although occasionally of high grade malignant most carcinomas of the rectum and rectosigmoid are known to be relatively slow growing; hence, it would expect considerable local growth before widespread metastases occur.

During a 2 1/2 year period up to January 1947 the authors have performed 29 consecutive resections of the upper rectum and rectosigmoid with primary end-to-end anastomosis without a single hospital death. The procedure was carried out as a palliative measure in 6 patients and with the hope of a cure in 23 patients. Preoperative preparation included adequate use of succinylsulfathiazole. Preliminary transverse colostomy was used in the presence of obstruction but not as a routine adjunct. Postoperative care included the use of blood fluids, and acids, penicillin and sulfonamides.

The authors state that the method is simpler than the closed method, the blood supply is better preserved and there is freedom from postoperative complications. No fecal fistulas have developed and all patients have maintained bowel control.

HARRY W. FINE, MD

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

The Pathogenesis and Different Forms of Jaundice. Torben K. With. *Acta. med. scand.* 1947, 18: 5.

Because of the numerous modifications of the theories published by Rich. in 1930, concerning the

pathogenesis of jaundice the author presents a review of the subject.

Jaundice is a yellow coloring of the skin which occurs simultaneously with hyperbilirubinemia. The plasma or serum threshold for jaundice in white adults is 15 to 20 mgm. per 100 ml. In babies it is 8 to 9 mgm. per 100 ml. It is believed that some responsible for the yellow color of plasma are rubin hifuscin, and mesobilifuscin.

The yellow color of the organs is due primarily to the deposition of yellow substances in the tissues and the yellow color of the circulating plasma plays only a minor role. It is evident that bilirubin does not enter the tissues by diffusion from the blood plasma into the tissue fluid. This is improbable since the bilirubin is firmly bound to albumen in the serum also when deposited in the tissues bilirubin is firmly bound to elastin. The combination therefore is responsible for the yellow color. The fate of bilirubin in jaundiced organs is unknown. In longstanding jaundice decomposition takes place but in the absence of chemical analyses of jaundiced skin this question cannot be settled.

The author believes that Rich's classification of jaundice will have to be revised as it is based on the behavior of the diazo reaction.

The author classifies jaundice into three forms

- (1) Production jaundice caused exclusively by increased bilirubin production
- (2) Retention jaundice, caused by the retention of bilirubin in the blood because of deficient liver function
- (3) Lymphogenous jaundice caused exclusively by the flow of bilirubin into the lymph spaces of the liver

These forms of jaundice are rarely found alone and they combine to account for the known clinical forms of jaundice.

Hemolytic jaundice production plus retention jaundice

Parenchymatous jaundice (hepatitis) lymphogenous (regurgitation) plus retention jaundice

Occlusive jaundice lymphogenous (abnormal secretion) plus retention jaundice

Icterus neonatorum lymphogenous (abnormal secretion) plus probably production jaundice

The lymphogenous jaundice in occlusive jaundice and icterus neonatorum is suggested to be due to a special secretory mechanism from the blood capillaries into the lymph spaces of the liver while in parenchymatous jaundice it is due to regurgitation into the lymph spaces opened by necrotic processes in the parenchyma.

The author suggests that the absence of bilirubin in the urine in hemolytic jaundice is a factor only of the low serum bilirubin level and has nothing to do with the diazo reaction.

Several possible explanations are given for the early bilirubinuria which precedes clinical jaundice. The problem of urobilinuria preceding bilirubinuria is discussed.

ROBERT R. BICKLOW M D

A Contribution to the Study of Epithelial Cysts of the Liver (Contributo allo studio delle cisti epiteliali del fegato) Silvio Flamini Arch. ital. chi. 1946 68 435

The author presents a case of epithelial cyst diagnosed preoperatively as hydrops of the gall bladder with atones and presents a review of the literature with various classifications of hepatic cysts. He believes that the cysts are due to inclusion of embryonal germ tissue derived from the cystic outline of the hepatic parenchyma. A comparison is made with polycystic kidney.

Up to 1938 about 100 cases had been reported. These cysts are much more frequent in women than in men. Various reports listing the ratio to males as 98 to 22 (Lenormant) and 17 to 8 (Mayo and Harrington). The ages at which it is commonly encountered lie between 40 and 50 years. However in most cases the condition had existed for many years before it was diagnosed at autopsy or operation.

The cysts are more frequently found in the right lobe of the liver. The findings may vary from single cysts to a polycystic liver. The evolution is gradual and there is a tendency of the cysts to grow toward the peritoneal cavity. The gross appearance is that of a rounded, smooth shiny cystic mass often transparent but usually tendinous in appearance. The masses are usually imbedded in the parenchyma and are pedunculated but very rarely. Sometimes they are arising from hepatic transplants are mentioned such as the case reported by Mayo with the cyst arising in the round ligament. The cavity is usually single but may be multilocular. The content is usually a lemon colored liquid varying in density from 1005 to 1025 with a neutral or alkaline reaction a high albumin content 4.5 per cent and more chlorides from 6 to 8 per cent, and usually no bile pigment. The content is usually sterile few cases being reported with infection. Microscopic study usually revealed some blood cells, hepatic cells and almost always cholesterol crystals.

The dimensions vary from that of a chick pea to one containing 9 liters. Symptoms vary and are usually due to pressure on the adjacent structures. Pain is not characteristic and is considered to be due to stretching of the visceral peritoneum with no relation to meals. The first symptom is usually that of noting a tumor in the right upper quadrant. Jaundice is usually not present.

The differential diagnosis is given in detail but is essentially that of a mass in the upper abdomen. Among the complications are hemorrhage, torsion, and rupture. Infection is rare and has been found only in patients who had been punctured for diagnostic purposes. In short, spontaneous infection of the cysts has not been recorded.

Therapy is essentially surgical in nature. The author recommends excision when possible, either enucleation of the cyst or resection with adjoining liver tissue. In the case reported the cyst itself was enucleated with ease and bleeding was easily controlled.

trolled with catgut sutures. Difficult cases have been marsupialized, but this prolongs the cure.

LOUISE J. FROSTOTT M.D.

Results in Gall Bladder Surgery Leonard W. Edwards and Charles K. Gardner *South. Surgeon*, 947 13 480.

The present article deals with some of the details which are important in gall bladder surgery and the authors give a summary of the results they personally obtained with operation in 200 cases of non-malignant biliary tract disease as encountered at the St. Thomas Hospital Nashville, Tennessee, from 1937 to 1947.

From the surgical standpoint, it is well to regard stone formation as a part of cholecystitis. It is well known that removal of nonstone containing gall bladders frequently results in failure to relieve symptoms, while removal of gall bladders containing stones usually results in cures. The high percentage of acute cholecystitis associated with cholelithiasis generally needs no further elaboration. A series of 18 acute cases showed 27 with stones, 96.4 per cent the overall series showed the presence of stones in 187 cases, or 93 per cent.

Just as most cases of cholecystitis deserving of operation will be accompanied by stones, so will most cholecystitis deserving of operation show either stones or a nonfunctioning gall bladder by properly performed and properly interpreted x-ray studies. Unless clinical evidence is strongly indicative of cholecystitis, a single x-ray report of a nonvisualizing gall bladder should be checked by repeating the x-ray studies.

It is becoming evident that fundamentally cholecystitis is a metabolic disease in which chemical and mechanical factors combine to produce repeated acute attacks characterized by vascular changes in the gall bladder. These vascular changes vary from mild congestion to gangrene. The process is a progressive one so that the risk and mortality in cholecystitis roughly parallels its duration being noticeably higher in persons past 50 years of age.

When bacterial infection is present in cholecystitis, it is a secondary process to metabolic, chemical and vascular changes. This concept of the disease is not unimpaired of infection but it leads the surgeon to realize that if the gall bladder is removed early in the acute attack infection will have had less time to develop. Danger of operation will be correspondingly less. Most patients are not seen by a surgeon at the onset of the acute attack, due to uncertainty of diagnosis and delay by medical doctors.

The patient with acute cholecystitis should be admitted to the hospital as soon as the attack occurs. An appraisal of the patient's physiologic and operative condition should be made on admission, and operation should be performed as soon as the patient is properly prepared. Usually this should be possible within 24 hours. Careful clinical observation should be made frequently in order to evaluate the course of the disease.

Laboratory procedures take second place to clinical observation and include blood amylase, albumin-globulin ratio, prothrombin level, nonprotein nitrogen, icteric index and liver function tests. Wengensteen suction is indicated if abdominal distention is marked. Intravenous glucose and amino acids should be given as indicated to overcome dehydration, protein deficiency and diminished liver function. In jaundiced patients, parenteral injection of vitamin K and repeated blood transfusions are indicated to overcome bleeding tendencies due to hypoprothrombinemia. Prompt administration of penicillin or other drugs may be indicated to combat or to prevent infectious complications.

Unless the patient is seen in the first 24 hours after onset of the attack, preparation for surgery can rarely be accomplished in less than 12 to 24 hours. Although many acute attacks might be delayed several days with safety the observation has frequently been made that often there is little correlation between the clinical severity of acute cholecystitis and the pathologic changes actually taking place in the gall bladder. Some apparently mildly acute cases perforate without warning. This bears out the need for delay only until the patient is in a satisfactory physiologic condition for operation.

The acutely ill, jaundiced patient with gallstone obstruction presents the most difficult problem. The most dependable sign of a progressive process with impending perforation is continued or increasing abdominal pain and rigidity.

From a technical standpoint, there are several details worthy of attention. Whatever incision is used it is advisable to obtain adequate exposure so as to visualize the structures about the common duct. The transverse incision has the advantage of less postoperative pain and fewer wound disruptions.

The incision may be made across one or both rectus muscles as indicated for good exposure. Careful closure of the transversalis fascia and peritoneum lessens the incidence of wound disruption and hernia.

The authors prefer to expose the common duct, cystic duct and cystic vessels by blunt dissection, and to remove the gall bladder from below. They point out that the danger of injury to the bile ducts and right hepatic duct has been stressed too little.

Postoperative care of patients with gall bladder disease should follow the same principles as those used in preparing the patient for surgery. Early moving in bed and early walking help prevent pulmonary complications. BENJAMIN GOLDMAN M.D.

The Persistence of Symptoms Following Cholecystectomy Nathan A. Wornack and Russell L. Ordor *Ann Surg* 947 126 3

Clinical and experimental evidence obtained from observations on both animals and man shows that stimulation of the nerves distributed along the common and cystic ducts results in symptoms identical with those occurring in biliary tract disease. It is not the persistence of a large cystic duct, per se,

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that results in the presence of symptoms of biliary tract disease after cholecystectomy but rather the inclusion in the scarred walls of the duct of bundles of nerve fibers chiefly sympathetic in type, with perhaps a smaller number of vagal fibers. At times fibrous tissue proliferation in type, with peritoneal form of amputation neuroma. Since both the anterior and posterior plexus tend to converge in the region of the cystic duct, it is sometimes easy to include many of these fibers in the ligature about the cystic duct. In such cases there may not be true neuroma formation, but rather a constriction and ischemia of the nerve fibers in a region subject to variation in intraductal tensions during the day. Another type of lesion found in the nerve plexus results from the laying down of a diffuse sheath of dense fibrous tissue over the anterior surface of the common duct, in the region of the stump of the cystic duct. When this is examined microscopically it shows the same type of nerve trunks encased in scar tissue.

The presence of scar tissue around nerve trunks produces stretching of the fibers and ischemia. Both of these factors lower the threshold of stimulation of nerve endings and nerve trunks. The presence of the damage found in these cases, therefore, makes the nerve fibers more susceptible to stimulation so that a mild stimulus, normally almost imperceptible may produce a very marked effect. The position of the ducts about the expanding and contracting common duct, and occasionally the contracting common duct, and the expanding and contracting common duct, is also a factor in the production of these postcholecystectomy symptoms several months after the operation.

As a rule, after cholecystectomy several months elapse before the recurrence of symptoms. This is in keeping with the time required for the laying down of the dense collagenous scar. In many instances after the lapse of several years symptoms disappear and complete degeneration of the damaged nerve trunks.

In order to prevent the appearance of these postcholecystectomy symptoms it is advisable whenever possible to separate the nerve trunks mesial to the common bile duct. In most cases this is easily done if the peritoneum and underlying areolar tissue are removed from over the common duct before the gall bladder is resected. The nerve trunks are then well visualized. Should such treatment of the common duct appear to be dangerous it is best to strip completely the cystic duct of all its adjacent structures as well as the cystic artery. In this way none of the nerve fibers is caught in the ligature.

A similar procedure is carried out in those patients who have to be operated on for the so-called postcholecystectomy syndrome. The stump of the cystic duct is removed close to the common duct. Any scar on the surface of the common duct is carefully removed. The nerve trunks as a rule thus become well visualized on the mesial side of the common duct, and can likewise be destroyed.

SAMUEL KATZ M.D.

Disease of the Cystic Duct. Stasis of the Bile in the Gall Bladder Due to Hypertonicity and, Eventually, Sclerosis of the Sphincter of Oddi. (La maladie du cystique. Stases vésiculaires per de Luthens) P. Mallet-Guy R. Jeanjean and J. Ferroldi *Lyon chir.* 1947 41 174.

In the pseudobiliary pain syndrome treatment by routine cholecystectomy or cholecystogastrostomy although undeniably giving many successful results is not to be condoned. In these dilated gall bladders which otherwise seem to be normal and for which surgery is indicated as a result of the failure of medical measures the authors have been injecting fluid (water) into the exposed gall bladder and overcoming the resistance of water pressure necessary to passage of the fluid. Where the curve of the cystic duct to the manometer has risen steeply to 15 or 50 cm in the pressure of the fluid. The curve of the water enough a cystic block has been diagnosed and a cholecystectomy performed. The stump of the cystic duct is then catheterized and a control radiograph is made to determine the permeability of the sphincter of Oddi. In the presence of resistance of the sphincter a transduodenal sphincter may be accomplished at this or at a secondary operation. In the present series, a cholecystogastrostomy was done only once and this with discouraging results. Some operations on the sphincter and vagus nerve were carried out but the number of cases was too few for any idea to be gained of the efficacy of the procedure.

As regards the results obtained with cholecystectomy alone in 8 cases the results were excellent for the time the patients were observed. In 12 other patients the results were imperfect, but the improvement was estimated at about 50 per cent by the patients themselves. In 1 patient the painful attacks reappeared but could be largely controlled by the patient (beta-phenylisopropylamine). Finally in 9 other patients a follow-up has been impossible because the patients themselves report that their pain, attacks and functional disturbances have been entirely relieved.

The authors believe that cholecystectomy is an efficacious method of treatment of "disease of the cystic" when surgery is indicated however it is not to be done without preliminary assessment of the functional condition of the principal bile duct, as difficult as this assessment may at times prove to be.

JOHN W. BARKMAN M.D.

MISCELLANEOUS

Surgical Aspects of Amebiasis. P. Theron. *Brit. M. J.* 1947 2 133.

During the recent war amebic colitis was so prevalent that it constituted a major problem for the medical services. Of greater importance however was the disturbingly high relapse rate after treatment. It seems likely therefore that the complications of amebic dysentery will play an important

part in post war civilian practice. In the surgical sphere an infection of this type is apt to give rise to considerable difficulty in diagnosis, and may at the same time exert a great influence on the course and outcome of surgical ailments and in particular on the results of operative treatment.

The mortality rate following operations on patients suffering from untreated and often undiagnosed amebic infection is considerable. This is largely explained by

- 1 The reduced resistance as a result of the chronic infection with consequent increase in the number and severity of postoperative complications. A factor of importance is the frequent association of hypoproteinemia with amebic infection (Faust 1930 Elsdon Dew 1946). The predisposition towards the development of postoperative complications caused by this type of deficiency is too well known to require amplification.

- 2 The interference with wound healing with the occurrence in some cases of ulceration and sloughing of the skin of the abdominal wall. This complication is especially apt to occur after the establishment of a colostomy.

- 3 The tendency to breakdown at the suture line after operative intervention on the bowel. Consequently procedures such as intestinal anastomosis, appendicectomy etc. may be associated with the development of fecal fistulas and general peritonitis.

- 4 The development of acute amebic dysentery during the immediate postoperative period—probably the result of handling of the bowel during opera-

tion. In most cases this is of little moment, provided that early treatment is instituted. On occasion, however, the condition may simulate bacillary dysentery in the severity of the diarrhea with a consequent adverse effect on the prognosis. It is of interest that this phase of acute diarrhea may occur within 48 hours of operation in patients suffering from severe general peritonitis. This was a feature in 3 cases in which the development of paralytic ileus had appeared almost inevitable. Stool examination revealed the presence of numerous free forms of *Entamoeba histolytica* with ingested erythrocytes.

- 5 During the postoperative period a mild hepatitis is not uncommon. Spontaneous remission is usual but occasionally a progressive form is encountered. Many of these postoperative complications are likely to occur in Britain during the post war years. Failure to recognize the cause may be disastrous. Thus it would be good policy to view with suspicion every candidate for operation who has seen service in a tropical or subtropical zone, whether or not a history of dysentery is elicited and, where possible, preoperative investigation in the form of sigmoidoscopy and stool examination should be employed. After emergency operations a watchful eye should be kept for complications suggestive of amebiasis, so that early and energetic treatment may be instituted if necessary.

The results are given in a series of cases which include infection of the liver, perforation of the colon, acute infection of the caecum, and intestinal obstruction due to amebiasis.

CHARLES BARON, M.D.

GYNECOLOGY

ADNEXAL AND PERIUTERINE CONDITIONS

Meigs's Syndrome; A Case Report and a Review of Recently Published Cases Herbert J. Simon
Am J Obst., 1947 53 1042

The author reports a case of Meigs's syndrome from the City Hospital, New York, New York. He also tabulates a synopsis of 17 additional cases that have been published recently which brings the number of reported cases of this syndrome to 44. The patient was a 55 year old woman who appeared to be in a hopeless condition. The significant findings were a bilateral hydrothorax that filled the right side of the chest, a large abdominal tumor the size of a full term pregnancy and associated with ascites and a tremendous femoral hernia that extended from the right inguinal area to the knee. Twenty five hundred cubic centimeters of serous fluid were removed from the right chest and on the following day a large smooth firm and round tumor of the right ovary about 27 cm in diameter was removed. The patient made a rapid convalescence and was in good health 9 months later. The tumor was a fibroma of the ovary.

The importance of giving every patient who presents the triad of tumor, ascites, and hydrothorax the benefit of operative exploration is emphasized. This is true no matter how hopeless the condition of the patient appears on the first examination. Many patients with this syndrome are in all probability being overlooked.

JOHN R. WOLFE, M.D.

Granuloma of the Fallopian Tube Due to Surgical Glove Talc. G. B. S. Roberts. *Brit J Surg* 1947 34 417

Seven cases of silicious granuloma are described 2 occurring in appendectomy scars and 5 in the fallopian tubes.

A historical review and case reports are given. The lesion occurring in a scar wound was characterized by the development of a mass in the scar of a previous operation wound with moderate pain or discomfort at this site. A differential clinical diagnosis must be made from a keloid which generally develops within a year of operation.

All 5 patients with lesions in the fallopian tubes had undergone a previous laparotomy for appendectomy and, apart from 1 who had an abortion the patients were all sterile. The symptoms were suggestive of a low grade pelvic inflammation and physical examination revealed thickened tender fallopian tubes.

Microscopy revealed the presence in all the lesions of doubly refractive material, this was considered to be talc deposited at the earlier operation. A differential diagnosis from tuberculosis of the tube especially the proliferate form had to be made. It would seem reasonable in the microscopic examination

tion of the pathological fallopian tube to accept as primarily silicious a giant cell granulomatous reaction with scanty or absent endothelioid cells without caseation and presenting doubly refractive material within or closely related to the giant cells.

The lesions produced by the introduction of talc into the tissues or body spaces probably are more common than is generally believed. Treatment is prophylactic. When once the silicious particles are deposited it is improbable that surgical treatment could prevent the ultimate occlusion functional if not organic of the fallopian tubes.

T. FLOYD BELL, M.D.

MISCELLANEOUS

Diverticulitis of the Colon in Gynecology Edward Allen and L. Bruce Donaldson. *West J Surg* 1947 55 393

Diverticulitis of the colon is a frequent disease of middle and old age. It is more common in the female than in the male. Because of the symptomatology of the disease a gynecologist is frequently consulted. Since 1934 362 patients with diverticulitis have been admitted to the Presbyterian Hospital in Chicago. Of these 223 were females 59 of whom were seen in consultation with or were treated by members of the gynecological staff. The series of 59 cases is presented.

In the present study colon diverticulitis has been found to be a frequent cause of left lower quadrant pain, bladder irritation, and pelvic mass formation. The authors urge that any patient with this clinical picture particularly if she be over 35 years of age, be thoroughly investigated by roentgenography and stool examination before surgery is undertaken. Barium enema and a roentgenogram of the colon make the best single diagnostic facility. The characteristic film in colon diverticulitis reveals saw toothed serrations with a long bowel segment. There is evidence of break in the bowel continuity. Fluoroscopic examination may add valuable information. The sigmoidoscope will prove of value in establishing the diagnosis in a high proportion of cases but examination is believed to be of no value. Stool examination is recommended primarily to rule out amebiasis.

The predominant symptoms of chronic constipation, diarrhea, gas formation (abdominal distention, belching and flatulence) and abdominal pain point of course to a disturbance in the gastrointestinal tract. On the other hand abdominal pain and the frequent complaints of backache, bladder disturbances, fever and the presence of an abdominal mass point rather to a localized pelvic disorder. In this series, for example the gynecologist's diagnosis was cystitis in 4 patients with diverticulitis of the colon who had severe bladder complaints. These symp-

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toms are frequently present when adhesions or infected diverticula impend on the bladder. Other mistaken diagnoses made in the series presented were as follows: pelvic inflammatory disease in 8, ovarian cyst in 5, uterine fibroids in 8, pregnancy (tubal and intrauterine) in 3, and ureteral stone in 3.

The authors stress the fact that if the patient is thoroughly studied the diagnosis of diverticulitis of the colon can be made and the patient properly treated. The palpatory pelvic findings of a tender, fixed, leavlike mass flowing out from the region of the sigmoid colon plus careful roentgen examination of the bowel should save many patients needless laparotomies.

L. JAMES TALBOT, MD

Surgical Care of Urinary Incontinence in Women

R. W. To Lindo. *Ann. Surg.* 1947 126 64.

The author observes that incontinence of urine in varying degrees in women is one of the common complaints heard in every gynecologic clinic. When the symptom is of a marked degree there is nothing more distressing to the patient. Not only is there the physical discomfort associated with constant moist

and local irritation but there is an unmistakable odor of decomposing urine which is annoying to the patient and those in proximity to her.

In general surgical results to cure this condition are not as satisfactory as they should be. This is shown by the great number of women who seek relief at the larger clinics, after undergoing previous unsuccessful operations. Of the many reasons for these failures one of the principal ones is the lack of knowledge of the exact anatomy of the parts and the failure to know completely the physiology of micturition. Another is the lack of training in female urology of surgeons, gynecologists, and obstetricians who attempt plastic operations to restore continence. The author's experiences of the past decade are reviewed in the article presented.

The types of incontinence considered in this series are summarized as follows:

1. Stress incontinence of different degrees, varying from slight, occasional loss of control on severe straining at coughing, sneezing, or lifting heavy weights to almost complete incontinence which occurs with the slightest exertion. Stress incontinence is usually associated with cystourethrocele, with or without uterine prolapse. Occasionally this condition is seen without these conditions and even in nulliparous (usually elderly) women.
2. Vesicovaginal fistulas due to childbirth injuries, surgical injuries and destruction of the vaginal and bladder walls by malignant disease of the pelvic organs and/or irradiation therapy.
3. Defects in the urethra and sphincter, due to congenital defects, obstetrical and surgical accidents, or destruction by malignancy or lymphoplasia retroperitoneum.
4. Incontinence due to neurologic disease, such as spina bifida, multiple sclerosis, or tabes dorsalis.
5. Ureterovaginal fistulas due to operative or radiation injuries.
6. Inflammatory lesions of the urinary tract, causing such marked frequency and urgency as to result in practical incontinence. This type is not included in this series but it is important that it be recognized and differentiated from those types in which there is

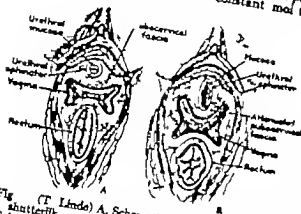


Fig. 1. (T. Lindo) A, Schematic representation of normal urethral sphincter. B, Schematic representation of failure of urethral sphincter to close on straining after development of urethrocele. (Courtesy of J. B. Lippincott Co.)



Fig. 2. Aldridge modification of Gossell-Stoeckel operation for urinary incontinence. A, Fascial strips are being separated through Pfannenstiel incision. B, Fascial

strips shown in position around posterior portion of urethra. Dotted line indicates position of rectus abdominis muscles contracted. C, Slinglike action of the fascial strips.

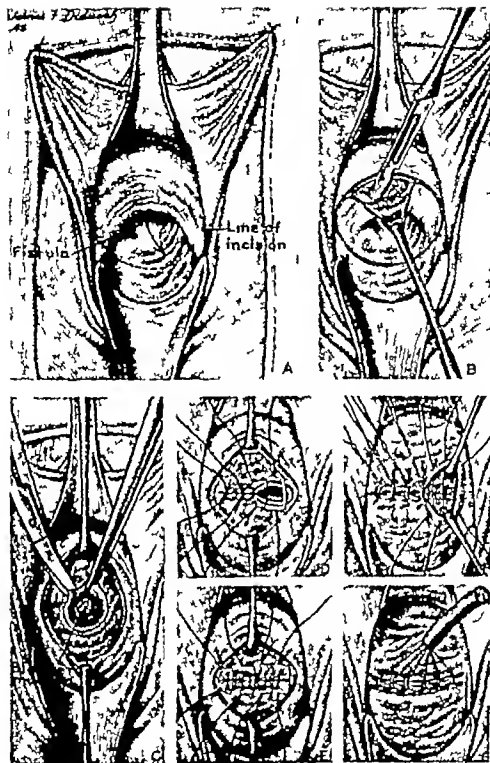


Fig 3

a defect in the sphincter mechanism or bladder or ureteral walls.

Stress incontinence is many times more frequent than all of the other types combined. It is the simplest type to cure surgically and yet results are not uniformly satisfactory. During the past 10 years, 249 operations for stress incontinence were done on the Gynecological Service of the Johns Hopkins Hospital, Baltimore. Of the patients 90.3 per cent

reported that they were well, 5 per cent that they were benefited, 3.5 per cent that they were not benefited, and there was no data on 1.2 per cent.

There is more than one etiologic factor in stress incontinence. The explanation for the incontinence in the cases associated with urethrocele or cystourethrocele lies in the sagging of the urethra and base of the bladder. Defects in the pubovesicocervical fascia, which normally supports the urethra and blad-

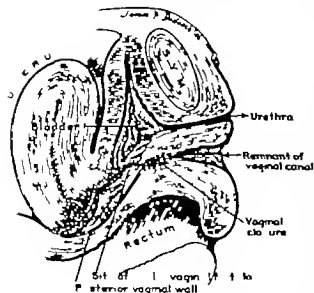


Fig. 4. (Fe Linda.) Demonstrating use of Latako principle of partial colpocleisis for cure of vesicovaginal fistula in the presence of cured cervical cancer

der are responsible for both urethrocele and cystocele. The stress of coughing, sneezing, and other physical exertion forces the unsupported undersurface of the urethra and bladder downward, while the anterior surface remains in apposition to the symphysis. This prevents the urethral sphincter muscles from closing in a normal concentric manner and the resulting oval sphincter aperture fails to completely shut off the flow of urine (Fig. 1). The women without cystourethrocele usually present themselves after middle age, and the only explanation which can be offered is a decrease in sphincter muscle tone which occurs with advancing years. Still other women who suffer from stress incontinence are found to have scar tissue in the periurethral region which prevents the camera shutterlike action of the sphincter muscle.

The author discusses the operative procedures for the cure of stress incontinence and notes that the procedures are the plication of the vesical sphincter musculature and reuniting of the pubovesicocervical fascia fibers beneath the urethra and base of the bladder. A description of the operation performed by Kelly is presented and the operation done by the author is described. If a cystocele is present, an incision is made through the anterior vaginal wall from the cervix to within a half centimeter of the urethral meatus. If there is no cystocele, the incision is carried only the length of the urethra and for about a centimeter beyond beneath the trigone. The vaginal mucosa is dissected laterally the fascia being stripped from it. This fascia is to be used for subsequent plication to form a floor on which the urethra and bladder base rest. If a cystocele is to be repaired, the usual advancement operation is done with plication of the pubovesicocervical fascia in the midline. A series of mattress sutures of medium silk are taken,

beginning about a centimeter beyond the vesical end of the urethra and extending to within a half centimeter of the meatus. When the incontinence is marked the internal sphincter region can be more tightly plicated by taking 2 or 3 mattress sutures at that point, each succeeding suture burying the preceding one.

Because of the cases that are unimproved after the operation by plication it is necessary to find another method to cure stress incontinence. After one or more unsuccessful plications, scar tissue may make further plication futile. Moreover, in the case in which the urethra and sphincter mechanism have been destroyed the reconstructed urethra has no contractile power and this must be supplied from some other source. In certain neurologic bladder with incontinence there is the possibility that a new sphincter mechanism can be supplied which will function sufficiently well to give the patient control. For these conditions, the author uses a modified Goebel-Stoeckel operation. This type of operation has been done 13 times in his clinic during the past 10 years, and has been successful in all but 2 cases. This failure was apparently due to a great excess of scar tissue resulting from the previous attempts at plication.

This type of operation is described in detail (Fig. 2). Contrary to the objections of some, there was no hemorrhage nor injury to the bladder in the operation. Care is taken in each case to secure the proper amount of tension on the strips of fascia to give the patient continence. This is tested by distending the bladder through a glass catheter and creating moderate repressurable pressure.

The history of vesicovaginal fistula is briefly reviewed. In the study of the causes of vesicovaginal fistula in 41 cases, it was found that vaginal delivery caused 8 cases and total abdominal hysterectomy was responsible for 15 cases. Of 41 patients operated on 37 were cured. A discussion of the principles that have contributed to the success of this series of difficult operations is presented. The advantage of having the tissue in the best possible condition before attempting closure is great. After the occurrence of a fistula 5 or 6 months should elapse before surgery is attempted. The approach to the operative field should be given considerable thought. The vaginal approach is the one most favored. Even a deep vagina can be made relatively shallow by episiotomy.

The Latako method of closure of high vesicovaginal fistulas is recommended because it is so well adapted to the ever increasing number of fistulas following total hysterectomy (Figs. 3 and 4). Although partial colpocleisis is undesirable, the inconvenience is nothing compared to that of the pre-existing incontinence. In no case has a vesicovaginal fistula been approached transvesically by the author. The technique for the closure of the fistula is presented. To test the bladder closure the author uses a weak solution of sterilized milk. If there is a very slight leakage, the drop of milk stands out very plainly against the bloody background. The milk does not stain the tissue as does the methylene blue solution.

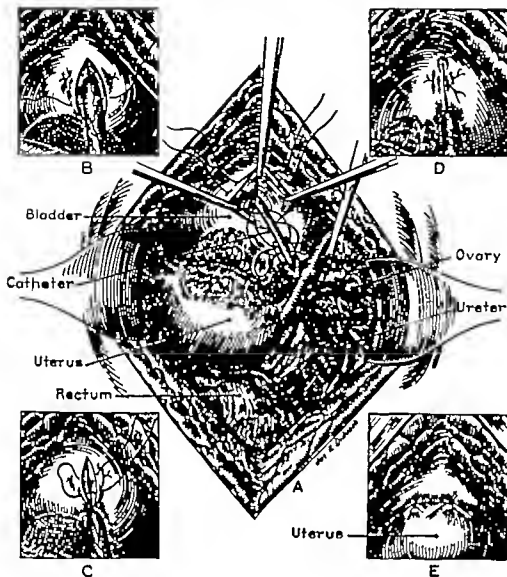


Fig 5 Implantation of ureter into bladder. A. ureter has been dissected free and cut across. Opening has been made through broad ligament into bladder and end of catheter has been introduced into it. Mattress sutures have been placed in end of ureter passed into bladder and cut through wall of bladder. B. Mattress sutures have been tied and a fixation suture placed through bladder wall and muscular coat of ureter. C. Bladder wall incision is approximated with a mattress stitch. D. This mattress stitch has been tied, and implantation has been completed. E. Uterus and serosal surface of bladder are sutured together to relieve any tension that might develop at anastomosis.

The author notes that many a perfectly executed operative closure is ruined by improper postoperative care. The essential point in postoperative care is bladder drainage. Frequently double drainage is provided in the form of a therapeutic vesicovaginal fistula or suprapubic drainage in addition to the indwelling urethral catheter. The vaginal cystostomy closes spontaneously in a remarkably short time, after withdrawal of the catheter 2 weeks later. If the incision has not been made through scar tissue ninety per cent of the fistulas in this series were cured by the application of these principles. Among the most difficult cases of incontinence to cure surgically are those resulting from complete

destruction or congenital absence of the urethra, including the region of the internal sphincter. Occasionally this may occur as a result of childbirth injury. The operation for restoration used by the author is briefly described.

Incontinence of urine due to ureterovaginal fistula usually results from operative injury to the ureter. While in some cases of injury urine may appear in the vagina almost immediately following the operation, more often the lower ureter sloughs as a result of accidental crushing or interference with its blood supply. Then urine appears in the vagina several days after the hysterectomy. To differentiate between a vesicovaginal and uterovaginal fistula the

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bladder may be filled with methylene blue solution. If the vaginal urine is unstained, it is the ureter which communicates with the vagina. It is desirable to allow as much as 6 weeks to elapse before undertaking the anastomosis of the segments of the ureter. If the operation is undertaken too soon, the pelvic tissues in the region of the ureter will be edematous. If one waits too long the function of the kidney will be reduced or even completely destroyed. The indications for and the types of implantation to be performed are presented and discussed. A discussion of the technique of a ureterovesical anastomosis is given (Fig. 5).

The author concludes by noting that from this review of the experiences of the past decade it is apparent that most cases of urinary incontinence are curable surgically. In order to effect a cure in a high percentage of cases, surgical principles which have evolved out of the experience of many operators during several decades must be heeded. Ingenuity in planning each case and meticulous care in executing the surgical procedures are essential but the reward is a successful outcome which transforms the life of the patient from an almost unbearable existence to that of a normal woman.

HERBERT F. TRUXTON, M.D.

On Pelvic Neurinomas in the Light of an Internet
Ing. Case. *Oldi Hietalaivara. An. chir. gyn. fenn.*
1947 36 7

An interesting case of pelvic neurinoma of the pelvis is described. This type of tumor was first described in 1908 by Verocay. While neurinomas have been described in other parts of the body their presence in the pelvis is uncommon, only 7 such cases having been reported. The case report becomes remarkable on account of the location of the tumor. Ganglioneuromas are the most common of the pelvic nerve tumors.

The tumor in the author's case was the size of a fist however the great majority of the neurinomas remain relatively small. Cesarean section was performed because of obstruction of the true pelvis.

Later the tumor was removed surgically because of symptoms of pressure. It was found to be retroperitoneal, solitary and originating from the anterior surface of the os sacrum.

Diagnosis is usually difficult. The only possible treatment is the surgical removal of the tumor. Radiotherapy has no effect. The prognosis is good.

T. FLORE BELL, M.D.

Clinical Study of Hydatid Mole (Clínica de la mola hidatídica) J. M. Bedoya. *Rev. esp. obst. ginec.* 1947 4 1

There are 3 types of moles to consider: the bloody mole which is merely a coagulated mass of blood more or less organized; the teratologic type which may or may not contain a fetus or some part of one; and finally the hydatid or hydatidiform mole. The last is characterized by the formation of a large number of vesicles hanging on a pedicle appearing much like a cluster of grapes. It is known by several terms such as vesicle mole, gestation mole, uterine hydatid, choriomyxoma, and degenerative cyst of the chorion villous.

The affection is a serious one as it often occasions the death of the fetus, endangers the mother and requires urgent intervention, much as malignant trophoblasts of the trophoblast and chorionepithelioma types.

According to the author the frequency of occurrence varies from 0.05 to 3.70 per 1000 and the condition is seen more often in multiparous women. The symptoms usually found are amenorrhea, expulsion of the vesicles, hemorrhage, pain, vomiting and other subjective signs of pregnancy and enlarged uterus or varian tumor. It is impossible to demonstrate a fetus. The mole may be expelled spontaneously or retained, or it may instigate a serious pelvic infection.

Treatment consequently resolves into one of expectancy or interference. The condition is treated either by hysterectomy or evacuation of the uterus medically by oxytocics or surgical interference.

STEPHEN A. ZIEGLER, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

The Etiology of Primary Abdominal Pregnancy (Per la genesi della gravidanza addominale primitiva)
Luigi De Giorgi Arch. ostet. ginec., 1947 52 1

Six normal deliveries in a 41 year old pluripara were followed by a placenta previa centralis for which a cesarean section on the uterine fundus was done. In the present pregnancy which was near term there were pains in the lower abdomen great tenderness to palpation and attacks of slight bleeding from the vagina. No evidence could be elicited that the fetus was alive. The subsequent symptoms of severe acute anemia indicated a laparotomy during the operation a massive hemoperitoneum and a large fibrin covered saclike formation containing a dead fetus was encountered. The child weighed 3,000 gm. and was 49 cm. in length. Subtotal hysterectomy with removal of both tubes and ovaries followed. The tubes and ovaries were apparently normal. The sac and placenta were attached to the fundus of the uterus the area of insertion involving the healed cesarean scar of the uterine fundus and extending to the left almost to the point of insertion of the left tube. The body of the uterus was enlarged measuring 11 cm. in height and 7.5 cm. in breadth. When it was opened the walls were found to be irregularly thickened and the cavity was lined with an membrane partially necrotic decidualeike

Histologically the muscular walls were intact forming a continuous layer of irregular thickness between the uterine cavity and the area of serosal implantation of the placenta and sac. Even surrounding the intramural portions of the tubes which areas were examined. In serial section the encompassing muscle tissue was intact. The serosal covering of the tubes and ovaries was smooth and continuous, the mucosal folds within the tubes were normal in appearance with evidence of decidual or regressive changes and there was no other evidence of primary attachment of the ovum in these structures. On examination of the area of placental attachment to the uterine fundus the chorionic villi were observed to extend down from a distance of about 2 cm. among the muscle fibers of the uterine wall, but were separated from the muscle tissue by wide lacunae filled with blood. The chorionic reaction had evidently produced some fibrosis and byaline degeneration in the muscle tissue but there was no clear evidence of decidual response. Nevertheless directly beneath the placental attachment and also scattered irregularly in the muscle tissue were some glandlike cavities lined by a necrotic desquamating epithelium. The muscular uterine wall particularly in the area of scar left from the previous hysterotomy, was noticeably thinned. The endometrium showed in addition to the necrotic changes observed macroscopically ad-

vanced decidual changes. The histologic findings in the placenta itself were about those of an ordinary placenta at term. The wall of the fetus containing sac was covered on the outside by layers of fibrin type and was lined by a single layer of low epithelial cells which were rich in protoplasm. The fresh status of the organs and other tissues of the dead fetus indicated that it had died recently.

The author believes that the case would be most logically considered an instance of primary abdominal pregnancy. It is regretted that the pregnancy had advanced so far that no conclusion could be formed as to the original conditions present in the area of nidation of the ovum. However the evidence of defective healing of the original hysterotomy scar (glandlike cavities) would suggest that an ectopic endometriosis may have spread as far as the serosal surface of the uterine fundus in the area of oval implantation. It is true that the conditions observed do not fulfill all the postulates of Veit however it is concluded that in view of the knowledge accumulated since 1903 these postulates are no longer tenable in their strictest sense.

JOHN W. BRIDGMAN M.D.

The Management of Ovarian Tumors Complicating Pregnancy Henry C. Paik and Irving A. Bunkin. Am J Obst 1947 54 82

Ovarian tumors are tumors of the childbearing period and they may thus complicate a pregnancy. The presence of an ovarian tumor therefore is as a rule no barrier to conception. Twelve cases of ovarian cysts complicating pregnancy are reported. In general, all the criteria which influence the handling of ovarian tumors in the nonpregnant patient apply equally as well to the pregnant patient.

Dermoid cysts are found to be a common complication of pregnancy. Dermoid cysts were present in 7 of the 12 cases, and in 2 of these the condition was bilateral.

The small ovarian cyst (5 cm.) is usually one of a group of functional cysts and it is rarely a cause for concern before or during pregnancy. Larger cysts should be removed when they are discovered in the nonpregnant patient. All lesions suspected of being solid tumors of the ovary should promptly be surgically inspected. Bilateral tumors also must promptly be submitted to surgery.

The medium sized and larger tumors discovered at the onset of gestation may be removed safely during the first trimester of pregnancy under general anesthesia, preferably cyclopropane. Instances of removal of both ovaries during the second and third month with no interruption of the coexisting pregnancy have been reported. Torsion intracystic hemorrhage and infection are the commonest complications during pregnancy. Torsion and infection occur most frequently during the postpartum period.

Ovarian tumors discovered during the second trimester of pregnancy should be removed at that time. In the elderly primipara it may be advantageous to delay oophorectomy until term at which time cesarean section may be done.

In patients in whom the ovarian cyst is discovered at term and delivery of the fetus through the natural passages is imminent, the ovarian cyst should be removed soon after delivery in view of the potential danger of torsion and infection. The cyst which makes for a dystocia problem at term should be removed at the time of the elective cesarean section.

JOHN R. WOLFE, M.D.

LABOR AND ITS COMPLICATIONS

Manual Removal of the Placenta. A Report of 418 Cases of Manual Removal of the Placenta with 1 Death; 150 of the Removals were Done as a Routine or Prophylactic Measure Harry W. Mayne, *West. J. Surg.* 1947 55 453

Four hundred and ten cases of manual removal of the placenta are reported from the Methodist Hospital in Brooklyn. One hundred and fifty of these were taken from 234 personal obstetrical cases of the author observed over a 10 month period. Only 1 death occurred, and there was a morbidity of 7.6 per cent. No deaths occurred among the 150 personal cases of the author and the corrected morbidity of this group was 0.66 per cent.

Vaginal antiseptics was used routinely and may have been a factor in the low morbidity. The technique of this vaginal antiseptics was as follows:

On admission to the hospital the perineum was sprayed with a 2 per cent solution of mercurochrome and the vagina was irrigated with 3 drams of the same solution. This was repeated every 12 hours until the patient was ready for delivery. At this time the perineum was cleaned with soap and water and sprayed with a 2 per cent acetone alcohol solution of mercurochrome. The perineum was then depressed and 3 drams of a 2 per cent solution of mercurochrome in glycerine were poured into the vagina. When manual removal of the placenta was anticipated the latter procedure was repeated three times.

Early manual removal of the placenta is indicated in the presence of an anticipated difficult third stage. The following conditions predispose the patient to a difficult third stage: polyhydramnios, twin pregnancy, a large baby, adherent placenta (placenta accreta), long labor, difficult delivery, version, or placenta previa.

The author believes that the hazard of infection can be overcome by routine vaginal antiseptics during labor and at delivery and that the blood loss, shock or trauma which may occur with the Crede maneuver or in the 1 or 2 hours delay following delivery may be prevented. Sulfu drugs and penicillin should be used if vaginal antiseptics is not provided, otherwise they are not necessary. There was very little blood loss in this group of patients. No patient was given a transfusion during her stay in the hospital.

Although manual removal of the placenta immediately following delivery is an apparently harmless procedure when vaginal antiseptics are used during labor and at delivery it is not recommended as a routine procedure.

HARRY FIELDS, M.D.

NEWBORN

Icterus Neonatorum; Its Incidence and Cause Leonard Findlay, George Higgins, and Margaret W. Stanley, *Arch. Dis. Child.*, Lond., 1947 22 65.

Icterus neonatorum occurs in anywhere from 10 to 80 per cent of the newborn, according to the various estimates. Since the detection of jaundice is influenced by many factors such as the vascularity of the skin and the nature of the light in which the observation is made, and since there are several definitions of jaundice, such varying estimates are not surprising.

The authors' study is based on an investigation of children born in the Maternity Department of the Radcliffe Infirmary, Oxford, and was undertaken with the idea of (1) determining the incidence of icterus neonatorum, (2) trying to detect any difference in the rate of hemolysis in jaundiced and nonjaundiced infants, and (3) discovering any evidence of impairment or immaturity of liver function.

The diagnosis of icterus neonatorum was made on the basis of a hyperbilirubinemia in the cord blood or postnatal blood of an otherwise normal infant. Hyperbilirubinemia is defined as a plasma bilirubin level greater than 1 milligram per cent. This arbitrary level is chosen as it is unusual to find in a normal adult a plasma bilirubin level above this figure.

Seventy-three infants were observed once during the first 10 days of life and of these 34 infants (46%) had plasma bilirubin levels between 1.5 and 20.0 milligrams per cent at the time of the examination. Eighteen infants with levels above 2 milligrams per cent showed jaundice. All infants with bilirubin levels above 5.0 milligrams per cent showed icteric discoloration of the skin and mucous membranes. The higher the level of fetal bilirubin the greater is the chance of the development of jaundice.

No correlation exists between cord plasma bilirubin concentration and the maturity of the fetus. There is also no absolute correlation between the fetal level and the postnatal rise of the plasma bilirubin. Hyperbilirubinemia was present at some stage during the first 10 days of life in 81 per cent of the cases. Premature infants are more likely to develop jaundice than the mature ones. All infants born before 35 weeks developed jaundice, 67 per cent born after 36 weeks developed jaundice, and only 47 per cent of term infants developed jaundice. These figures refer to actual jaundice and not just hyperbilirubinemia.

Several factors have been suggested in the past as possible causes of icterus neonatorum. Excessive hemolysis or hepatic immaturity or both, have been most frequently mentioned.

Evidence is presented to indicate that red-cell destruction and bilirubin formation take place in the newborn at a rate no greater and perhaps lower than in adults. It, therefore, seems probable that the hyperbilirubinemia is due to the failure of the liver of the newborn child to excrete the pigment at the normal adult rate. It is only after birth that the liver starts to take on many of its functions.

There is reason to think that at birth the route of bilirubin excretion changes suddenly from the placenta to the child's own liver and if the child's liver were functionally immature at birth a temporary accumulation of bilirubin in the blood could readily be explained.

The authors have investigated the state of hepatic function by a study of the plasma protein and Takata Ara reaction during the first 10 days of life and of the excretion of fecal bilirubin during the first 5 days of life. There is no correlation between the changes in the plasma protein, as measured by the Takata Ara reaction and the degree of hyperbilirubinemia. It is evident that the changes in the plasma protein do not reflect the ability of the liver to excrete bilirubin.

Fecal bilirubin studies revealed a tendency to earlier and greater excretion in the nonjaundiced infants, with the lowest and slowest excretion in the severely jaundiced infants.

The authors conclude that their studies support the view that icterus neonatorum is due to hepatic immaturity.

HARRY FIELDS, M.D.

On the Prophylaxis of Hemolytic Disease of the Newborn. Donald H. Karlier and Dorothy I. Miller. *Am J Obst.*, 1947 54: 1

Hemolytic disease of the newborn may be diagnosed in the as yet unborn infant by routinely testing the sera of all Rh negative mothers during their pregnancies for the presence of one or more of the Rh antibodies and obtaining titers of the amount of antibody if any is present. Being aware before delivery of the fact that an infant with hemolytic disease of the newborn is to be delivered, one can make preparations for the proper treatment of the infant following its birth. This preparation and treatment resolves itself into having available Rh negative blood of the proper group and giving the infant a transfusion immediately at birth or as soon thereafter as seems justified by its condition and, particularly, by the red blood cell and hemoglobin levels. Repeated blood transfusions are nearly always necessary. Although this form of treatment has been helpful and has reduced the mortality from this disease, it is far from satisfactory.

The ideal treatment which would actually be prophylactic in nature is the treatment of the mother during her pregnancy. This treatment could be directed at one of three objectives: (1) the prevention by some chemical means of the antigen-antibody reaction from going to completion; (2) the absorption of the antibody as soon as it is formed by means of Rh haptene injections; or (3) inhibition of antibodies

by some immunologic means. The authors attempted the third method by giving a patient weekly injections of typhoid vaccine with the thought that a stronger antigen would prevent the weaker Rh antibody formation, but she was delivered of an infant which died from hemolytic disease of the newborn on its fourth day of life. Rh haptene has not been obtained in any form which would make it useful clinically.

The authors present 3 cases of patients who have been treated with the first objective, the prevention by some chemical means of the antigen-antibody reaction going on to completion. In 2 patients the condition was due to an Rh incompatibility in 1 to O-A incompatibility. All 3 patients had been previously delivered of one or more infants who died of hemolytic disease of the newborn as proved by autopsy and study of the placenta.

Since the production of this disease is essentially an antigen-antibody reaction, the idea suggests itself that if one portion of the reaction is eliminated, the reaction cannot go on to completion. Since the antigen is the fetal red cells, some process of preventing the production of antibody formation or of destroying it as rapidly as it is being produced must be achieved. Since the disease is produced by the continued action of the antibody in the maternal serum on the fetal cell antigen, the elimination of all antibody from the maternal serum would prevent the hemolytic disease.

With this fact in mind the authors used a drug ethylene disulfate 1:10-15 dilution in triple distilled water. Since the amount of the drug injected (2 c.c. of the 1:10-15 dilution) is so infinitesimal the authors believe that the results are due to the tissue damage produced by the distilled water and the liberation of an "x" substance which when picked up by the blood stream will neutralize all the circulating antibody. The 3 patients were given 2 c.c. of the drug in weekly intramuscular injections during the last 3, 4, and 6 months, respectively.

By following the therapy described 2 patients were delivered of infants who were normal and healthy both at birth and on subsequent examination. Although the third patient was delivered of a baby with hemolytic disease, the previous pregnancies had resulted in a stillbirth due to hydrops fetalis and an abortion. This infant was alive and responded to transfusion.

The method is presented with the hope that others will corroborate the findings, and not as a cure for hemolytic disease of the newborn.

JOHN R. WOLFF, M.D.

MISCELLANEOUS

Uterine Accommodation of the Products of Conception; Physiologic Considerations. S. R. M. Reynolds. *Am J Obst.*, 1947 53: 901

The size and shape of the gravid uterus is a necessary and primary subject of interest to the obstetrician. When it is given consideration it is usually with

respect to the morphology of the uterus or to the size of the conceptus with respect to the estimated age of the pregnancy. More recent studies made on infirmities suggest that still other attributes of uterine accommodation of the products of conception will bear the attention of clinician and experimenter alike, for these pertain to important physiologic mechanisms that are concerned with fetal growth and welfare. The new data have already yielded conclusions which promise to provide a common basis upon which certain of the functional and seemingly unrelated, difficulties of late pregnancy may be explained. Uterine accommodation of the products of conception appears to be the common physiologic denominator to these situations.

The local circulation of the maternal blood in the uterus decreases gradually as the fetus increases in size. Suddenly as the fetus reaches maximum ovoid size a profound transitory decrease in uterine circulation (uterine ischemia) takes place. The fetus changes shape abruptly by elongation and with this, there is restoration of a rapid circulation of the maternal blood through the uterus. The existence of an ovoid shape with respect to the conceptus even though intrauterine pressure is low imparts a relatively high degree of tension about the conceptus.

In pregnancy hypertrophy of the uterine tissues is associated with uterine distention by an ovoid conceptus. Consequently it takes place at the time of maximum uterine tension. After elongation of the products of conception, uterine growth decreases sharply and at this time there is the least possible increment in uterine tension with fetal growth. The last trimester of pregnancy (when fetal growth is most rapid) consists of "paying out" tissue elements which increase first by hyperplasia and then undergo hypertrophy in earlier periods of pregnancy.

Since transitory uterine ischemia is a necessary concomitant of conversion of the conceptus from an ovoid to a cylindrical shape, the possible consequences of abnormal manifestations of this on the welfare of the maternal organism, of the fetus, or both, is suggested. The essential application of this discussion to practical obstetrics is that it emphasizes the physiologic basis of proper change in shape of the uterus for normal pregnancy particularly about the beginning of the last trimester of pregnancy.

Uterine ischemia of given degree or duration may bring harm to the maternal organism by giving rise to toxic manifestations, or it may give rise to local conditions which jeopardize the continuance of the pregnancy or the viability of the fetus.

JOHN R. WOURT M.D.

Lymphogranuloma Venereum in Obstetrics.
Charles M. Steer *Am J Obst* 1947 54 230.

Lymphogranuloma venereum is a virus disease which produces a small primary lesion and systemic manifestations in its early stages, and localizes later in the genitalia and lower bowel. It is a rare disease in general and even more rare in association with pregnancy.

At the Presbyterian Hospital in New York, New York the diagnosis of this disease was made in 14 cases during a period of 15 years (an incidence of 0.045 per cent). On the obstetrical service (Sloan Hospital for Women), there were 8 cases among 22,500 admissions in the same period (an incidence of 0.036 per cent). Seventy five of these occurred in women of whom only 7 were white.

There were 45 patients in this group who became pregnant before the disease developed. The remaining 30 never became pregnant. No patient conceived for the first time after the disease appeared. Thus, this disease leads to an impairment of fertility.

When conception occurs in a patient with rectal or genital involvement there may result a normal pregnancy and a spontaneous delivery but in other cases (and it is impossible to predict which ones these will be) there may be a flare-up of the disease during the pregnancy or the rectal involvement may proceed to the point of complete intestinal obstruction. Because of these possibilities, it would seem wise to advise against pregnancy in a patient with active disease or with a rectal stricture. Termination should be considered if pregnancy has occurred in such a patient. The chief danger which exists at the time of delivery is that of rupture of the rectum. In the reported cases this has always resulted in death and this accident has been associated with an operative procedure in all but 1 case. This means that vaginal delivery of a patient with rectal stricture exposes her to the possibility of irreparable damage.

It is true that a number of patients with complications have been delivered from below and this number is greater than the number of those who have died. But with so great a risk, it would seem wiser to deliver all patients with rectal strictures or the genital syndrome by cesarean section. When that cannot be done the delivery may be allowed to take place normally if operative interference is kept to a minimum, and, when interference cannot be avoided, the manipulations should be as gentle as possible.

JOHN R. WOURT M.D.

Analysis of Therapeutic Abortions at the Bellevue Hospital, 1935 to 1945. Irving K. Perlmutter
Am J Obst 1947 55 1008.

While the occasional necessity for the interruption of a pregnancy, to preserve the life of a mother has been recognized since ancient times, the difficulty of defining the borderline between such therapeutic procedures and criminal abortions has always existed. Neither the legal nor the medical profession has helped to clarify the issue, since the former has failed to provide a clear statement of society's attitude, while the medical profession has failed to define the conditions which call for a therapeutic abortion.

An analysis of the therapeutic abortions performed at Bellevue Hospital, New York, from June 1, 1935 to May 31, 1945 was undertaken in order to re-evaluate the policy for that institution. It was found that 199 pregnancies were interrupted on the gynecologic

service while during the same period 15 119 women were delivered on the obstetric service. The incidence of therapeutic abortion was therefore 1.23 per cent, or a ratio of 1 therapeutic abortion for every 76 women delivered.

The indications for therapeutic abortion have been under constant revision since this procedure was first introduced. The earliest indication noted in the literature of the eighteenth century was for contracted pelvis. In the middle of the following century a gradually increasing scope was evolved which embraced indications for cardiac disease, tuberculosis and many neurologic and psychiatric disorders. The use of therapeutic abortion continued to broaden until the turn of the century when the first evidence of conservatism became apparent and the medical profession took a more critical view of the indications. That this trend continues is indicated by the present analysis.

The survey is divided into two 5 year periods with a ratio of one abortion to every 64.6 women delivered in the first 5 years, and a ratio of one abortion to every 93 women delivered in the second 5 years. The relative trends within groups show an apparent increase in tuberculosis (47.89%) an apparent unchanged incidence in the cardiac and toxemia-pyrexia indications, and an apparent decrease in neurologic and psychiatric indications. The large groups containing all the remaining miscellaneous indications for therapeutic abortion also show a declining incidence. Several can be removed from the present day indications by recent advances in medical management.

A comparison of the number of therapeutic abortions performed with the number of deliveries of

women with the same medical complication showed that the indications for all therapeutic abortions are on the decrease, whereas the number of deliveries of women with the same medical complication is on the increase.

Management of Postabortal Peritonitis. Henry C. Falk and George Blalock. *Am J Obst* 1947 54 314.

An analysis of 61 fatal cases of postabortal peritonitis not associated with perforation of the uterus seen at the Harlem Hospital New York New York, showed the inadequacy of conservative therapy. Not 1 patient who was proved to have postabortal generalized peritonitis recovered. Because of this knowledge and the similar experiences of others the entire problem has been restudied and since 1941 selected cases of postabortal peritonitis have been treated with surgery.

Since 1943 24 cases of generalized postabortal peritonitis have been seen at Harlem Hospital. Thirteen patients were not operated upon and all of these died.

Surgery was performed on 11 patients and 8 of these have survived. The surgical procedure consisted of hysterectomy with splitting of the cervix and vaginal drainage. This was combined with appropriate chemotherapy. Multiple blood transfusions and intestinal drainage. For technical reasons and to decrease shock, supracervical hysterectomy with splitting of the posterior lip of the cervix and the insertion of multiple drains into the pelvis is preferred to total hysterectomy. Vein ligation was not employed and is not deemed an essential adjunct to surgery.

JOHN R. WOLFF M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Tumors of the Kidney A. P. Graham. *J Urol* Balt., 1947 58 10.

Initial symptoms in 70 per cent of 195 patients with malignant tumor of the kidney were hematuria and pain 31 per cent, or about one-third of these patients, complained of hematuria only.

The finding of a palpable mass in 41 per cent of the patients at initial examination indicated that the diagnosis of cancer of the kidney was made very late.

Retrograde pyelography was diagnostic in 66 per cent of the pyelograms taken. Compression of one or more calyces (59 per cent) and distortion or compression of the pelvis (22 per cent) comprised 81 per cent of the significant pyelographic findings.

Intravenous pyelography was diagnostic in only 16 per cent of the pyelograms compared with 66 per cent for the retrograde.

Eighty-six per cent of the tumors were considered to arise in the parenchymal portion and 14 per cent were pelvic or calyceal in origin. The squamous tumors did not metastasize widely whereas the transitional cell neoplasm produced extensive metastases to many organs and structures. Sixty per cent of the transitional cell tumors had become implanted in the ureter or bladder during the period of observation or previously.

Metastases were found in 70 patients or 36 per cent, at the time of initial examination. Forty-eight per cent of these were in the lungs, 23 per cent were bone metastases, 9 per cent were in the liver, 7 per cent were proved brain metastases, hence 7 per cent of the metastases were in the lungs or bone.

Bone metastases were most prevalent in the ribs, ribs, and pelvis.

Finding 41 per cent of the tumors inoperable when first seen would indicate that not much has been accomplished toward early diagnosis of cancer of the kidney. At least in the group of cases with which we are dealing. And further in 21 metastases found at time of surgery 8 were found inoperable because of local extension.

There were 28 per cent 3 year cures, 17 per cent 5 year cures, and 14 per cent 10 year cures.

JOHN A. LOSE, M.D.

Biological Assay of Kidney Tumors by Heterologous Ocular Transplantations. M. H. Blaska. *J Urol* Balt., 1947 58 1.

The tumors of the kidney utilized in this investigation comprised (a) 1 papilliferous epithelioma of the renal pelvis from a white man aged 37 years, (b) clear cell carcinoma from a white woman aged 61 years and (c) 1 granular cell carcinoma from a white man aged 60 years.

In this group a total of 9 transplantations were effected with 1 positive histological result, while in 3

instances the histological evidence was equivocal and in another 3 it was definitely negative. Transplant was completely absorbed, and in the last case the result was indeterminate.

In the positive result, the transplant was surrounded by a fine network and a pseudocapsule due to a desmoplastic reaction originating in the host (guinea pig). In this positive transplant, the morphological characteristics of the original tumor were maintained without aberrant changes in the cells or nuclei.

There were 3 clinically positive results, the transplants increasing in size with alterations in color and vascularization but the histology of the transplant did not reveal any definite evidence which would suggest viability of the transplant when examined on the sixteenth, twenty sixth and thirty third post-transplantation days. Histocytes were predominant in these transplants, together with leucocytic infiltration. Again, in the 3 transplants with equivocal results it was not possible to reach a definite conclusion because the cells which questionably simulated granular cell carcinoma did not display irregularity in their size, shape and staining reaction, and in the staining reaction of the nuclei, features which are suggestive of malignant proliferation.

JOHN A. LOSE, M.D.

BLADDER, URETHRA, AND PENIS

Treatment of the Paraplegic. G. J. Thompson, M. N. Nourse, and H. C. Bumpus, Jr. *J Urol* Balt. 1947 57 685.

Teamwork between the various departments involved in caring for the paraplegic is essential to maximum recovery. In the past the principal cause of fatality has been infection of the urinary tract, therefore restoration of function of the bladder and prevention of deterioration of the kidneys are of primary importance and the urologist should direct the early treatment.

The authors present their observations of 101 patients suffering from injury or disease of the spinal cord. The majority of patients were below 40 years of age and the condition in most cases was caused by gunshot wounds or traumatic fracture. In 46 cases the lesion was above the tenth vertebra and in 55 cases at the eleventh thoracic vertebra, or below.

In a general discussion of the cases, hemithorax is mentioned as being the most debilitating complication and the most important single therapeutic agent was found to be a palatable high protein diet provided by 4 meals daily.

The type of drainage varied. In 19 cases a suprapubic cystostomy was done and in 81 cases drainage was through urethral catheters (No. 18 Foley bag being most satisfactory). Tidal drainage was used in the majority of cases but not exclusively or con-

unusually. It was found that irrigation with a pistool syringe kept the bladders cleaner than did tidal irrigation alone.

Stones were observed to form in the bladder to 67 patients in 11 cases stones formed in one kidney and in 8 cases both kidneys were involved. Early mobilization and adequate hydration were found to be the best preventatives of stones.

In this group transurethral resection of the vesical neck was done in 58 cases, in some instances 2 or 3 resections were required. The authors observed that most patients manifest one of two types of neurogenic dysfunction: (1) the so-called automatic or reflex type of bladder or (2) the so-called retention type, with overflow incontinence. The reflex bladder was established most speedily in cases in which the injury was above the tenth thoracic vertebra and which the injury was below the eleventh thoracic vertebra. The authors believe that in the latter group with lesions of the cauda equina the bladder becomes an overflow bladder with varying amounts of residual urine present at all times and that it is these cases which are most responsive to resection.

Cystoscopic examination shows various degrees of relaxation of the neck of the bladder—some cases present a constriction of the internal urethral orifice, some have a bar type deformity and others may have a vocal cord appearance. All cases show trabeculation of the wall of the bladder and this is interpreted as a work hypertrophy caused by efforts of the bladder to empty. Relief of the obstructive element by resection will enable these patients to empty their bladders by straining their abdominal muscles.

The authors believe that it is safer to perform several operations than to attempt too wide a resection initially. The other condition in which transurethral resection is indicated is that in which a reflex bladder has been established but fails to empty well. Reoperation often results in a more efficient emptying.

Of 39 patients with injury below the eleventh vertebra and who had undergone transurethral resection, 36 had voluntary urination. An analysis of 43 cases in which resection was not necessary or not indicated disclosed that 13 patients had voluntary urination and 30 had efficient reflex type emptying. In this series satisfactory bladder function was established in 93 cases in 40 cases this was voluntary and in 53 automatic. The urine in 85 patients was grossly clear, and in 39 patients the urine was negative culturally. After the patient has dispensed with the use of a catheter and is free of stones there is a chance to sterilize the urine.

ROBERT G. BEADLES, M.D.

Utilization of X Rays in Tubercular Cystitis as a Preparation for Endoscopic Examination. Clin. Contrib. Tuberculari a scopo preparatorio alla esame endoscopico Contributo clinico. Eros Benedetti Ann. chir., 1947 24 128.

Three patients with tuberculous involvement of a kidney and a secondary tuberculous cystitis com-

licated in each instance by a banal pyogenic infection were given from 360 to 400 roentgens previous to an attempt at cystoscopy. In each instance the bladder was edematous congested, infiltrated and enormously contracted holding only from 10 to 30 c.c. One of the patients had been discharged from a surgical clinic in another city with the statement that cystoscopy was impossible. The irradiation was given from in front with protection of the genitalia. Each patient was given from 80 to 100 roentgens in each of 4 sessions at 2 day intervals. A penetrating ray (180 kw) was used and superficial caustic effects were guarded against by filters of 34 mm. of copper and 3 mm. of aluminum. The focal skin distance was 40 cm. With the first sessions the condition in the bladder would seem to become worse with greater tenesmus and a more turbid even sanguinopurulent urine. Within a few days however these manifestations would begin to clear up and within 2 or 3 weeks the bladder had become sufficiently relaxed to permit of satisfactory endoscopic exploration with a 100 to 130 c.c. capacity. One of the patients refused the nephrectomy operation and did not come back however the other 2 had their tuberculous kidneys removed and have remained perfectly well 3/4 and 1 year respectively.

Irradiation is not considered to attack either the tuberculous organism or the secondary invaders (staphylococcus streptococcus). The author thinks that this form of treatment exerts an effect on the congestion edema and infiltration produced principally by the pyogenic secondary invaders and perhaps some additional influence on the process of phagocytosis and the reticuloendothelial system in general. The method is harmless and requires much less time than the usual lavages, rest in bed and oral medications even should they be successful.

JOHN W. BRENNAN, M.D.

GENITAL ORGANS

Testicular Biopsy in the Sterile Male. Fred A. Simons and Ronald Sniffen. *Brit J Surg* 1947 55 503.

Since 1940 over 300 biopsies of the human testicles have been secured surgically by the author (Simons) and studied in conjunction with Ronald Sniffen Associate Pathologist. The cases include all types of endocrine abnormality in patients from 16 months of age to 73 years. From this group were selected 85 patients whose chief complaint was sterility. Testicular biopsy whose chief complaint was sterility only after the wives of these patients had been found normal. Sixty five wives were studied personally by the author and 16 of these achieved pregnancy following testicular biopsy. An attempt at epididymotomy or semididymotomy (artificial insemination from an unknown donor). Approximately 50 percent of the patients were operated upon as office patients. The procedure is innocuous, safe adequate and diagnostic. Pentothal and spinal anesthesia also were used.

The test is valuable as a means of deciding whether repeated azoospermia is due to block or germ plasma failure or in differentiation of patients who may and those who may not respond to treatment. There is little correlation between the microscopic findings and the findings at physical examination or between the urinary hormone assays and semen study except that all patients with too much follicle-stimulating hormone had malfunctioning tubular epithelium. By means of histological investigation the cases were thus classified and better understood.

HARRY W. FICK, M.D.

Study of the Vascularization of Autoplastic Transplantations of Testicular Tissue in Various Locations (Ricerche sulla vascolarizzazione degli innesti autoplastici di testicolo fatti in varia sede) Gaetano Bianchi and Guido Galeotti. *Spermatologia*, 1947 95 294.

Autotransplants of tissue blocks from the testicle of the rabbit were inserted into the animal's own testicle on the other side into a pocket of its peritoneum, and into its adductor muscles of the thigh. After periods of from 1 to 35 days the animals were sacrificed and the abdominal aorta was immediately injected with colored gelatin according to the method of Fassari. The object was to see if the blood vessels growing in from the implant bed of the host tissue would reunite with the vessels already present in the implant or if the revascularization would consist entirely of new formed vessels, the vascular network already present in the implant being disregarded.

It was found that the newly formed vessels from the bed did unite with the original vascular network of the implant, however the circulation was not returned to its original state. This renewed circulation was most extensive in the tissue taken from the animal's testicle and implanted into the testicle on the other side. It was not so satisfactory in the implantation into the omentum, and was almost nil in the implantation into the muscular tissues. However if observed long enough all the implants in this series, no matter what their place of implantation, eventually lost this original blood supply were invaded by newly formed vessels, and were absorbed and replaced by fibrous scar tissue.

The difference in response in the 3 locations forces the authors to conclude that an individual homogeneity exists, not only between the so-called nobler tissues, or parenchyma, but also as postulated by Fassari, between their supporting tissue, or stroma.

JOHN W. BROWN, M.D.

Gangrene of the Scrotum. R. G. Robinson. *Gry's Hosp. R. & Lond.*, 946 95 92.

The author reports 3 cases of gangrene of the scrotum, gives a cursory review of the literature and discusses the pathology and treatment of this uncommon condition.

The disease was first adequately described in 1834 but the etiological factors were not well understood

until Meleney in 1933 classified infectious gangrene of the skin into acute and chronic forms. The acute type consists of 2 varieties—gas gangrene and hemolytic streptococcal gangrene.

The latter gangrenous infection may follow a deep wound but more frequently follows a trivial injury. There occurs a sudden onset of pain to the involved part with swelling of the site of injury which becomes hot and red. The pain gradually leaves but the area of redness spreads rapidly during the first 3 days. The marginal edges are not raised. The temperature is between 101 and 102 F with severe prostration. A small gangrenous patch appears between the second and fifth days with rapid spreading of the necrotic area. Distant subcutaneous tissue may become involved and many of the patients succumb to an overwhelming toxemia with septicemia. Hemolytic streptococci are always found associated with wound contaminants. The subcutaneous tissue is involved and thrombosis of the skin arteries results in secondary gangrene of the overlying skin. The disease has been reproduced in rabbits by injecting hemolytic streptococci subcutaneously.

The author states that infectious gangrene due to hemolytic streptococci and gangrene of the scrotum are one and the same disease. Cases reported by others due to associated organisms are probably sub-varieties of the disease. The author considers gangrene of the scrotum as a variety of hemolytic streptococcal gangrene that may affect any part of the body.

Surgical treatment of gangrene of the scrotum is fraught with a high mortality. The author believes that this disease is due to the hemolytic streptococci and should be treated with penicillin therapy alone.

PETER L. SCARFINO, M.D.

Studies on Intraocular Implantation. B. Krichsky and J. A. Benjamin. *J. Urol. Balt.*, 1947 58 114.

The administration of estrogens in doses up to 500 immunizing units per kgm. to intact animals produces a marked atrophy of intraocular prostate gland implants. This atrophy is reversible if the administration of estrogen is stopped.

After atrophy due to castration had manifested itself similar treatment of these animals produced marked hypertrophy of the intraocular prostate gland implants.

The atrophy in intact animals is due to glandular involution, while the hypertrophy observed in castrated animals is due to thickening of the fibrous and muscle tissue, and to hyperplasia and metaplasia of the epithelium.

It is suggested from this study that changes in the size of the intraocular prostatic gland implants in intact animals treated with natural and synthetic estrogens is the result of two processes: (1) atrophy due to glandular involution, and (2) hypertrophy due to fibromuscular changes and metaplasia of the epithelium. Usually the overall effect on the size of the prostatic tissue is reduction in the area of the transplant.

Intraocular prostate gland implants responded similarly to natural and to synthetic estrogens.
JOHN A. LOFF M.D.

MISCELLANEOUS

Urology in the European Theater: World War II
J. C. Kimbrough. *J. Urol.*, Balt., 1947 57 1105

The greater part of the urologic surgery of World War I was performed by the general surgeon urologist. Urologists were assigned to the task of venereal disease control and prevention. Between the two world wars, urology developed into a distinct surgical specialty. The urologists of World War II for the most part, were assigned to the surgical management of urological problems. The control and treatment of venereal disease was under the aegis of the Medical Service.

From June, 1942 until June, 1944 the urologic injuries were due to the activities of the army training program and to air combat. Automobile, jeep and motorcycle accidents accounted for the majority of injuries and these injuries presented no unusual problems to the civilian urologist. The greater part of this period was spent in preparation for the continental invasion.

From June, 1944 until May 1945 an efficient system of evacuation and treatment was set up on the continent. Urological treatment in the forward area consisted chiefly of the emergency management of wounds of the kidney and bladder and the conservation of tissue in injuries of the external genitalia. With victory on the continent, treatment was carried on without interruption of the patient physician relationship. In hospital centers, facilities for treatment were established in the various specialties.

From June to October 1944 147 bodies of men killed in aircraft combat were examined. Fourteen of these had injuries to the genitourinary system—9 had lacerations of the kidneys, 3 had ruptured or penetrated bladders and 3 received injuries to the external genitalia. Five of the 14 had received wounds resulting in fractures of the bony pelvis.

The mobile conflict on the continent accounted for an increase in the percentage of wounds due to high explosives. A cross-section review of 235 cases involved in 33 patients the kidneys were injured in 24, and the external genitalia in 160. There was a notable increase in the incidence of ureteral injuries which may have been due to better diagnostic measures. Conservative treatment of the renal injuries resulted in only 8 nephrectomies and 1 death. It was noted that ureteral injuries were frequently missed at primary operation because of the massive injuries sustained by these patients. When missed at the initial operation fistulas developed and nephrectomy was required. Early surgery in wounds of the ureter and bladder gave the best results. The repair of injuries to the external genitalia were performed as soon as practicable and tissue conservation was stressed.

Neurogenic bladders due to lesions of the brain and spinal cord were managed by (1) indwelling urethral catheters until the patient recovered, died or had a cystostomy (2) catheter drainage tidal or otherwise was maintained until bladder function returned, or it was determined that function would not return (3) suprapubic cystostomy at the end of 4 weeks or earlier if bladder function showed no evidence of return or if severe infection of the lower genitourinary tract developed.

Of the 193 patients with lesions of the nervous system, 130 had a cystostomy and 163 had catheter drainage, tidal or otherwise. Bladder function returned in 44 patients treated by urethral drainage in from 27 days to 56 days.

Attached to the article is an appendix copied from section A, chapter VIII, of the Manual of Therapy ETO May, 1944 which lists the methods of diagnosis and the treatment for wounds of the genitourinary system.

PETER L. SCARDINO M.D.

Urology in Naval Medical Corps, World War II
F. P. Twinnem. *J. Urol.* Balt., 1947 57 1129

An interesting account of the varied experiences of a senior United States Naval Medical Officer is reported by the author. It is based on 4 years of active duty in the United States and on Pacific Island bases. The duties of the medical officer were not limited strictly to the practice of his specialty or to the ordinary duties of medical personnel.

A comparison of the mortality figures of injuries to the genitourinary tract in World War I and World War II revealed a marked decrease in the recent war due to modern therapeutic methods in combating shock and infection and in the handling of casualties.

A tabulation of the case incidence and mortality resulting from traumatism, exclusive of combat casualties during the recent war in the United States Navy and Marine Corps personnel from 1942 through 1944 revealed a total of 38 cases of injuries of various types to the bladder with 3 deaths, 467 cases of injuries to the kidney (310 of which were due to contusions) with 1 death, 128 cases of injuries to the urethra with 1 death, and 7 cases of injuries to the ureter with no death.

Sustained dehydration, malnutrition, and debilitation resulted in a high incidence of urinary calculi which for the most part consisted of calcium oxalate and phosphatic calculi and were spontaneously eliminated or removed by cystoscopic procedures. It was noted that the incidence of urinary calculi was much higher in white personnel than in colored and almost nil among the Pacific Island natives.

Cord bladders were treated by tidal irrigation with an acid solution often combined with estrogenic and aluminum hydroxide gel therapy. When urinary calculi were composed of calcium phosphate or carbonate, magnesium phosphate, or triple phosphate these measures gave satisfactory results. Neurogenic bladders associated with vesical neck obstruction were treated by transurethral resection of the

obstructing tissue. Partial transection of the cord resulted in only 1 case of incontinence in a series of 40 cases reported by Prather. The author reports the promising results of the work of Hoen and Ney on the surgical treatment of cord bladder by anastomosing the twelfth thoracic and third sacral nerves.

The case incidence rate per 1,000 average strength of gonorrhea and syphilis during the 2 world wars revealed the average rate for gonorrhea during 1918 and 1919 was 55.40, whereas the average rate for the years 1942, 1943, and 1944 was 28.69. The average rate for syphilis for 1918 and 1919 was 14.55 whereas for 1942, 1943, and 1944 the average rate was 4.23. It was the author's impression that the venereal disease problem would increase immediately with the advent of peace after the recent war as it did after World War I.

Penicillin and sulfathiazole therapy combined cured 98 per cent of the cases of gonorrhea in a series of 1,100 cases at St. Albans Naval Hospital, St. Albans, New York. Satisfactory results were obtained in the treatment of syphilis with the following treatment schedules:

1. Primary seronegative 100,000 units of penicillin every 3 hours for a total dosage of 6,000,000 units.

2. Primary seropositive, secondary and latent 100,000 units of penicillin every 3 hours for a total dosage of 8,000,000 units.

3. First relapse or reinfection of previously treated syphilis cases 100,000 units of penicillin every 3 hours for a total dosage of 8,000,000 units. Concurrent intravenous injections of mapharsen (60 mgm.) twice weekly for 5 weeks for a total of 600 mgm., and intramuscular injections of bismuth subsalicylate in oil 1 1/2 c.c. (900 mgm.) each week for 5 weeks for a total dose of 1,000 mgm.

4. Second relapse of previously treated cases of syphilis 80 weeks of the mapharsen bismuth schedule.

Penicillin was used with satisfactory results in the treatment of yaws. The author observed the varied symptomatology associated with filariasis in the natives of the Pacific Islands. The Samoans were observed with advanced stages of the disease while the natives on Tarawa manifested few or no symptoms in spite of positive blood stream infection with microfilaria. The military personnel either did not contract the disease or when infected, showed only minimal symptoms. The microfilaria was never found in the blood of the military personnel. The disease runs a self limited course but requires active psychotherapy and rehabilitation because of the loss of libido and potentia. No permanent disabilities were noted among the military personnel who had the disease.

PETER L. SCARDINO, M.D.

War Wounds of the Genitourinary Tract O. S. Caalp. *J. Urol. Balt.*, 1947 57 7

The author reports his observations of 160 patients with injuries to the genitourinary tract who came under his supervision in the Communication Zone of

the European Theater of Operations during World War II. The causative agent in 67 per cent of the wounds was fragments from high explosive shells. Associated trauma to other systems influenced the treatment of the various urologic injuries. Fracture of the lower extremities or of the pelvis, or both, were the most frequent complications in the genitourinary injuries. Perforation of the intestines was the most frequent complication in all urethral injuries.

Fifty-four cases of wounds of the external genitalia without involvement of the urinary tract presented the same problems as soft tissue injuries in other parts of the body, except for the need of preserving as much penile and testicular tissue as possible. The residual infections were minimized by the generous use of antibiotics and sulfonamides. Repairs of nonabsorbable sutures gave the best results. Postoperative erections were satisfactorily controlled with diethylstilbestrol. The estrogens were discontinued after removal of the sutures with subsequent return of potentia.

The most common form of emergency treatment of the 86 patients with injuries to the urethra was suprapubic cystostomy. Twenty of the patients had defects in the anterior segment and six had posterior damage. Repairs of urethral defects were of three types: (1) purse string closures, (2) linear repairs, and (3) end-to-end anastomosis. The diagnostic methods of choice were suprapubic cystoscopic visualization and urethroscopy. The generous use of sulfonamides and penicillin including penicillin irrigations proved efficacious. The most rapid healing of the urethral mucosa was noted when No. 0000 catgut was used, the fascia being closed with cotton and the skin with fine steel wire sutures. Stilbestrol therapy controlled postoperative erections without sequelae. Urethral catheters were removed after from 7 to 10 days and dilatation was carried out within 1 days. In most cases postoperative strictures did not prove troublesome.

Four of the 36 wounds of the bladder occurred as the result of blast injuries. All 4 patients had some degree of hematuria, frequency and urgency of urination. Cystoscopy revealed numerous punctate hemorrhages in each case. With conservative therapy the 4 patients developed normal urine and the frequency subsided.

Although only 6 cases of ureteral wounds have been reported by the author, he believes that these injuries were of frequent occurrence but that the majority of patients did not reach the general hospitals. It was noted that all patients had bowel perforations but in only one case was the diagnosis made at the original operation for repair of the bowel injury. In the other cases the condition was not recognized until fistulas developed. The partially torn ureters healed over indwelling catheters, but complete division required end-to-end anastomosis or nephrectomy. Subsequent ureteral dilatations were necessary.

There were 48 patients with wounds of the kidney including 38 with penetrating or perforating wounds,

8 with renal contusion and 8 with blast injuries. All wounds were repaired or managed in the conventional conservative manner. The 2 patients with contusions of the kidney developed flank tenderness and microscopic hematuria, but healing occurred without sequelae. The 8 patients who had received blast injuries had costovertebral angle tenderness and hematuria. excretory urograms were normal. None of the patients had any localized trauma to the renal area. All recovered with bed rest and without sequelae. Twelve per cent of the 48 patients who had renal injuries required nephrectomy.

PETER L. SCARDINO M.D.

Functional and Morphologic Reactions of the Urinary Tract during the Course and Wane of Nephritic Colic (*Les réactions fonctionnelles et morphologiques de l'appareil urinaire au cours et au déclin de la colique néphrétique*) Jacques Milchon. *J. urol. méd.*, Par 1946-1947 53 201

Tabulated data of 33 cases are presented to illustrate intravenous urographic studies of the functional and morphologic reaction of the urinary tract to nephritic colic. The changes in the urogram are shown during the attack of pain during subsidence of the attack and the 2 following days and from 3 to 20 days after the attack. A control urogram was taken in 19 cases. The results all tend to confirm the spasmodic nature of nephritic colitis. The reactions noted included secretory changes as manifested by the absence of an image and fall of the concentration and reactions of the excretory passages either in the form of hypertonus and hyperkinesia, or in the form of lowered tonus and generalized or localized dilatations. The nephrograms demonstrate complete or partial invisibility of the usually hypo-

tonic excretory passages. The sequence of disorders was found to be as follows during the attack there was no image and the nephrogram (opacity of the excretory passages) was total and during the decline of the attack there was hypertonus and hyperkinesia of the excretory passages (with or without partial nephrography).

The following interpretation of these findings has been suggested

1 Total opacity of the nephrograms indicates stasis due to spasm of the calices and papillary sphincter

2 Absence of images may signify either an equivalent of the total opacity of the nephrogram but with a concentration too low to be visible or a temporary inhibition of the secretion due to an inhibiting sympathetic reflex.

3 The hypotonias and dilatations are secondary phenomena due to muscular fatigue following spasm

4 The partially opaque nephrograms in a state of hypotension indicate stasis due to poor function of the muscles of the excretory apparatus.

The practical conclusions to be derived from these studies are as follows

1 Dilatations following nephritic colic are not lasting and their presence is no indication for operation

2 The absence of the image, i.e. exclusion of the kidney cannot always be labeled systematically. The cessation of secretion is nearly always temporary and reversible so that this sign, likewise, is not an operative indication.

3 The urographic aspects (absence of secretion opaque nephrograms dilatations) are often quite typical enough to permit diagnosis in cases of invisible calculi or sand.

EDITH SCHAMCHER MOORE

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS MUSCLES, TENDONS, ETC.

The Initial Lesions in Acute Osteomyelitis (Les lésions initiales de l'ostéomyélite aiguë). Jacques Lereboullet *Rev orthop* Par 1947 33 77

The initial lesion in osteomyelitis is usually localized around the nutrient artery or its principal branches. The focus is surrounded by a zone of inflammatory reaction localized in the haversian canals, adjacent to a healthy zone. There is usually some periosteal reaction. Initially, the medulla is also affected and directly involved in the pathologic changes.

Acute osteomyelitis of the femur and tibia is discussed in detail, and roentgenograms and reproductions of microscopic sections of diaphyses which were resected when acutely affected with osteomyelitis are illustrated in the original article.

In adolescents, osteomyelitis localizes in the diaphysis or at the junction of the diaphysis and the metaphysis. If localized in the diaphysis it is found around the nutrient artery. If closer to the metaphysis it surrounds the main inferior or superior branch of the nutrient artery. These facts have been demonstrated on roentgenograms. Sometimes the diaphyseal type of osteomyelitis subsides without affecting the metaphysis. This is cited as proof that the initial lesion usually is localized in the vicinity of the nutrient artery. Acute osteomyelitis confined to the metaphysis is considered to be a benign form since a considerable number of cases do not go on to supuration. In the beginning the lesion is located around the main branch of the nutrient artery and often heals before it alters the bony structure sufficiently to permit visualization on the roentgenogram. In case rarefaction occurs it is usually localized at a site where the cortex is thinned. It usually disappears without leaving any trace of destruction.

Pathologic studies reveal that the major changes occur where the nutrient artery enters the bone. At this point, however, the cortex is very thick, which explains the fact that it takes a considerable period of time before the process reaches the extraneous structures. This also is the usual place for the development of sequestra. The clinical signs of osteomyelitis are preceded by the penetration of the abscess underneath the periosteum and rupture into the surrounding soft tissues. This fact is well demonstrated in the rare cases of central osteomyelitis in which a great portion of the medulla is involved with hardly any clinical manifestations. On the other hand, there are cases in which a large subperiosteal abscess is associated with only a small osseous lesion. These facts were discovered at operations in which a portion of the diaphysis was resected.

These findings help clear up the old controversy whether trauma is the cause of acute osteomyelitis.

A trauma can cause the break through of a small cortical abscess into the soft tissue which, of course, is followed by clinical signs. According to the violence of the organism and the resistance of the host, the infection may spread by way of the haversian canals farther up and down into the diaphysis and eventually reach even the metaphysis. The abscess may break through the cortex at any one of these points. These abscess formations have to be considered as secondary foci. The medulla may also be affected eventually, i.e. in the metaphysis. As mentioned previously it has the power of limiting the infection by the formation of zones comparable to the abscesses formed in the soft tissues.

All the evidence points to the fact that the majority of the sequestra are formed in the center of the diaphysis where the osteomyelitic lesions are most serious and the atrophylococci toxins the most active. Histologic examinations showed that the medulla was intact at the level at which the sequestrum was found.

Thrombosis of the nutrient artery alone cannot be made responsible for the formation of a sequestrum. The elimination of the nutrient artery of a bone (in an infant only) like in Ollier's operation or in cases in which entire periosteum covering the bone is scraped off to obtain increased growth of the bone, never gives rise to the formation of a sequestrum. A disturbed blood supply in the presence of infection contributes to the necrosis of bone.

The study of osteomyelitis has been impeded by (1) emergency blind drilling of bone which only adds insult to injury and (2) superimposed infection by too frequent dressings, or by the lack of a dressing once a draining sinus has formed.

The fact that acute osteomyelitis does not localize initially in the bulbous portion of the bone and that the medulla so frequently is free from infection definitely condemns the so-called emergency drilling of bone. Early resection of the diaphysis is contraindicated since the surgeon is never able to evaluate the actual destruction of bone because it does not correspond to the degree of soft tissue involvement. Finally it is important to realize that penicillin should be injected locally because it is unable to reach the focus of infection if given intravenously. The nutrient artery usually is thrombosed and the periosteum is separated from the bone in the areas of infection.

Many workers believe that the nutrient artery does not play an important part in the metabolism of bone. The nutrient artery supposedly is important in the development of the bone but loses its significance after birth. It can be assumed that in certain cases the artery remains patent allowing organisms circulating in the blood to settle there and cause the development of osteomyelitis.

GRODINSKY I. RABIN, M.D.

Treatment of Acute Osteomyelitis with Penicillin
 Report on 30 Cases (A penicilina no tratamento da osteomielite aguda) Flavio Pires do Carmo
 and Enrico Toledo do Carvalho *Rev Hosp Clin* 1947 2 1

Treatment of acute hematogenous osteomyelitis with penicillin prevents the formation or causes the dissolution of metastatic foci and causes the disappearance of the primary osseous lesion within 3 or 4 weeks in approximately 90 per cent of the cases. To obtain such results the treatment must be instituted early the dose must be adequate the medication must be continued for a sufficiently long period of time and the periosteal and metastatic abscesses must be drained.

The following steps are recommended by the author:
 1. Immobilization of the affected extremity in a splint for from 30 to 50 days.

2. General treatment consisting of daily intravenous administrations of from 1,000 to 2,000 c.c. of glucose or saline solution to combat dehydration toxemia, and acidosis; daily transfusions of from 200 to 500 c.c. of blood to fight bacteremia and secondary anemia; a high carbohydrate diet and the administrations of vitamins.

3. The administration of 15,000 units of penicillin intramuscularly every 3 hours, the total dose ranging from 1,000,000 to 5,880,000 units according to the patient's resistance; virulence of the micro-organisms and the time the treatment was initiated. The administration of penicillin is stopped 2 weeks after the return of the temperature and the leucocyte count to normal levels. Abscesses in soft parts are aspirated every third day and 5,000 units of penicillin are injected. The administration of penicillin is supplemented with from 20 to 30 gm. of sulfonamides.

When these rules are observed general and local clinical symptoms disappear rapidly; this is in contrast to the roentgenologic signs which persist a long time. This is due to the fact that penicillin transforms a septic necrosis into an aseptic one. The sequestrum acts like an autogenous graft, which requires a certain time for its rehabilitation.

The authors report 30 cases of acute osteomyelitis in which early institution of treatment with penicillin and the administration of sufficient doses prevented the development of a chronic form and avoided the necessity of an operation. JOSEPH K. NARAY, M.D.

Eosinophilic Granuloma of Bone. Robert N. Cooley and Glenn D. Carlson. *Texas J. M.*, 1947 43 64.

Ten cases of eosinophilic granuloma of bone have been observed by the author in the past 3 years. The symptoms include aching "bone pain" in the region of the lesion; localized tenderness which gradually subsides; localized soft tissue swelling, at first hard and tense with subsequent softening. Constitutional symptoms are usually absent although a low grade fever and leucocytosis may be present.

Eosinophilia was found in only 1 of the 10 cases. The sedimentation rate was found to be elevated in 3 patients who were in an early acute stage. It was

normal when ascertained in a chronic or quiescent stage. The roentgen picture is of a round or oval bone defect with a smooth margin and no bone reaction. The ribs and skull are most frequently affected, with less common involvement of the pelvis, shoulder girdle, long bones and vertebrae. Periosteal reaction may be seen in the ribs and long bones, and fine trabeculation may occasionally traverse the bony defect. The rate of growth may be quite rapid. Healing following roentgen therapy requires from 6 months to 3 years. No fatalities have been reported from eosinophilic granuloma.

The tissue found in these bony defects closely resembles that of the Schuller-Christian syndrome both grossly and microscopically. However, the 2 diseases run quite different courses.

The best results of treatment probably follow a combination of surgery and irradiation.

VERNON C. TURNER, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Experiences in the Use of Cellophane as an Aid in Tendon Surgery. A. W. Farmer. *Plast Reconstr Surg* 1947 2 207.

The author in attempting to prevent adhesions by interposing cellophane between the gliding surfaces has met with varying results, and he presents the unsuccessful cases as well as those which turned out well. His interest in and study of this material began in 1932 and included numerous animal experiments. He has found that completely surrounding a great length of tendon with cellophane has resulted in necrosis and finally rupture of the tendon due to tension. The blood vessels were unable to reach the tendon and necrosis was the result.

On human subjects, since 1936 the procedure has occasionally seemed indicated when the transmission of power from the muscles to the fingers was almost or completely restrained by adhesions. No 300 cellophane was selected as the best material.

The anatomy of the flexor tendons of the digits of the hand is discussed and the fact that the reflections of the sheaths on to the tendons carry the blood vessels is pointed out. The most common disabling injury to the flexors of the fingers and thumb is damage to the sliding mechanism in the area from the proximal transverse palmar crease to the distal digital crease. This results in the loss of the ability to flex the interphalangeal joints. Adhesions between the tendon and sheath in this area completely eradicate function, as this part of the sheath is firmly adherent to the bones and in some positions to the annular ligaments. The metacarpophalangeal joints can be flexed fully because the interossei and lumbrical muscles accomplish this motion and it is not dependent upon the sliding mechanism of the long flexor tendons. Five cases are presented to illustrate the varying results obtained.

1. In the first case the fifth finger flexor was surrounded by cellophane. The operation failed because

cause the skin was not well closed and drainage caused the removal of the cellophane and failure of the surgery.

2 In this case the index finger flexor was freed and a slip of cellophane was placed beneath it. The tendon was not surrounded. This resulted in normal function promptly.

3 All the flexors in a mass had become adherent and a large sheet of cellophane was placed beneath them. This resulted in great improvement in the total function of the hand but, of course, in no individual function of the tendon.

4 The index finger flexor was freed and a slip of cellophane was placed beneath it. No improvement was accomplished.

5. A slip of cellophane was placed beneath the freed fifth finger flexor and practically normal function was obtained as soon as motion was permitted.

The poor results are probably due to adherence of the tendon to the ends of the cellophane implant, and the author suggests the use of a longer strip of such implant than seems necessary extending it to the tendon insertion.

Good results have usually been apparent early and once obtained they have continued to be good. Poor wound closure was the cause of some poor results. Firm healing of the surrounding tissues must be obtained before motion is permitted.

NEWTON C. MEAD, M.D.

The Use of Absorbable Substances to Obliterate Bone Cavities and as Hemostatic Agents in Operative Procedures on Bones and Joints.
Joseph Buchman and John E. Blair. *J Bone Surg* 1947 29 630

In the treatment of chronic osteomyelitis, the authors have resorted to the primary closure of wounds resulting from the surgical procedures. They have used a technique consisting of the intramuscular administration of penicillin at 3 hour intervals for approximately 24 hours prior to a thorough saucerization of the osteomyelitic focus (under tourniquet control, whenever feasible) and the removal of all diseased and scarred overlying soft tissues. After the proper toilet of the wound with saline solution the cavity is flooded with normal saline solution containing 250 units of penicillin per cubic centimeter of fluid. The wound is then firmly closed in several layers without drainage. Adjacent sinus tracts are excised, whenever possible, and closed without drainage. If such a procedure is not feasible, the tracts are curetted and their openings are sealed with several sutures. Gauze soaked in penicillin-saline solution is used as a dressing and the parts are immobilized in a huge compression bandage of sheet wadding flannel bandage, and adhesive tape. The intramuscular administration of penicillin, started on the day before the operative procedure, is continued uninterruptedly for a period of from 10 to 24 days after operation according to the patient's range of temperature and upon the character of the healing of the wound. The dosage of penicillin varies, with

the sensitivity of the micro-organism to the antibiotic. In those instances in which the organisms are sensitive to 0.5 unit or less of penicillin per cubic centimeter, 50,000 units per dose are ordinarily given. When the micro-organisms are resistant to 0.5 unit or more, 30,000 or 40,000 units per dose are given. The concentration of the penicillin used locally in all instances, been 250 units per cubic centimeter of normal saline solution.

The treatment of chronic osteomyelitis by saucerization and primary closure of the wound under antibiotic influences has brought with it the problem of control of the hematoma which develops in the resultant bone cavity. It has further been noted that if the hematoma is too large to be organized rapidly a sinus results. The authors noted some delay of bone repair in the series of cases. This was in keeping with the findings in animal experiments by Lister and Frantz that absorbable gelatin sponge (gelfoam) showed a slight delay in healing of fractures as compared with those treated with fibrin foam. There seems to be little doubt that the presence of oxidized cellulose in the immediate vicinity of a fracture interferes with the normal processes of repair of bone.

The technique of the use and manufacture of gelfoam and oxycel, the operative procedure, substances used for hemostasis and filling of the cavity and various remarks concerning the case histories are given in tabular form. The use of oxidized gauze or absorbable gelatin as a vehicle for thrombin and penicillin in filling dead spaces or bone cavities appears to be inadvisable, from the authors' limited experience because of the large number of complications which interfere with the healing of the surgical wound by first intention. The use of oxidized gauze or absorbable gelatin with thrombin as hemostatic agents in the presence of troublesome oozing and bleeding is advisable, and at times invaluable notwithstanding the fact that the final healing of the wound may in a considerable proportion of instances, be delayed by temporary partial disruption incidental to the evacuation of collections of blood serum. The clinical difference in the character of the healing has led the authors to abandon the use of oxycel and gelfoam as fillers for bone cavities.

C. FRED GORDON, M.D.

Flexor Tendon Grafts to the Finger and Thumb.
Walter C. Graham. *J Bone Surg* 1947 29 553.

The loss of the flexor tendon to a finger or thumb greatly handicaps the function of the hand and especially involves the loss of pinch hook grasping and holding of objects by the involved digit. The most logical treatment is restoration of the flexor tendon function to the digit. When a flexor tendon has been cut for some time, the proximal end will retract, so that it is impossible to do an end-to-end anastomosis. The author reports views based on experiences with 141 flexor tendon grafts.

Tendon grafts are transferred primarily and no attempts to establish preformed sheaths were made in this series. The tendon graft is dissected out from

its donor site with the surrounding gliding mechanism intact. Pulleys are used in sites where the transferred tendon might bowstring. Tendons are not laid over bony surfaces. Considerable freedom is allowed in the new sheath to avoid necrosis and adhesions during the healing stage.

Not all fingers with lacerated tendons are amenable to grafting. Primary consideration should be given to sensation. An extensively scarred finger does not lend itself to tendon repair. It is often preferable to fix the distal interphalangeal joint and insert the new tendon into the middle phalanx. It is most difficult to restore flexor tendon function in the little finger. Generally attempts at repair should be made only when it is an occupational necessity. As a rule, the sublimis tendon is excised and the profundus tendon assumes the control of the distal joints of the finger. A tendency for the proximal interphalangeal joint to go into hyperextension is avoided by fixing the stump of the sublimis tendon across the proximal interphalangeal joint into the proximal phalanx with the joint held in about 10 degrees of flexion. In cases in which the laceration is distal to the proximal interphalangeal joint the sublimis function can be retained and a graft can be extended to the distal phalanx and fixed proximally to the stump of the profundus tendon. The finger joints should move as freely as those of a normal finger before a graft is attempted. An effort should also be made to restore the muscle tone as it is extremely important that sufficient motor power be present to mobilize the tendon through the sheath.

The most accessible and frequently used graft has been that from the palmaris longus. Often the excised sublimis tendon will serve. The long extensor tendons of the toes are available but have the tendency to fray on handling. The peroneus longus or plantaris muscle tendons may be used. Precaution should be taken to avoid use of too large a tendon that will become necrotic in the center and cause more local reaction and thus adhesions. Occasionally tendons from other individuals have been used satisfactorily.

The site of suturing a tendon graft is extremely important. Suture should never be made between the proximal interphalangeal crease and the distal palmar crease. Distally the graft may be sutured to the stump of the profundus tendon or into the distal phalanx. Proximally the suture line should lie in the base of the palm or above the wrist.

The procedure of tendon grafting first includes excision of scar tissue and the stump of the old tendon. In many cases it is necessary to transfer flaps to scarred areas prior to operation for tendon grafting. The author reports better results by fixing the distal end of the tendon graft into the phalanx according to the Bunnell technique with pull out wire. Proximally Bunnell techniques of pull out wire or silk suture are satisfactory. In the base of the palm, the suture line is wrapped with the sheath of the lumbricalis.

In a flexor tendon graft to the thumb the graft is fixed distally with a pull out wire and the proximal

suture line is well above the wrist. If there is extreme scarring in the base of the palm, threading of the tendon outside of the carpal canal may be done.

Frequently advanced atrophy of the muscle unimproved by preliminary strengthening exercises leads the author to substitute a healthy muscle for motor power. He cites use of the sublimis tendon of the ring finger to motivate the index finger, middle finger or thumb. Muscle switching can be carried out without jeopardizing the function of the donor finger.

The most important part of flexor tendon grafting comes after surgery has been completed. The hand and wrist are splinted for 21 days. During the fourth week gentle active and passive motions are instituted. After 4 weeks moderate resistive exercises are instituted and in 6 weeks flexion against resistance is encouraged.

The technique of freeing the flexor tendon graft in its newly formed sheath is extremely important. Each joint should be held individually and forceful active flexion should be encouraged. This should not be done in less than 6 weeks after the operation. In practically all instances a snap will be felt as the tendon is freed in the sheath and an increase in the flexion function will be noted immediately. If the function of a graft has not been restored in 8 weeks the prognosis is discouraging.

Operative tendolysis by stripping the tendon after 6 or 7 weeks frequently will restore considerably more function. If either the distal or proximal suture line pulls apart, immediate regrafting gives gratifying results. When patients are reluctant to put sufficient flexor pull on the grafted tendon because of pain, infiltration ulnar or median nerve blocks are instituted to promote vigorous flexor muscle exercise. This frequently is done after 4 weeks. Occupational therapy has been very helpful in aiding in the restoration of function.

KEMATH H. SPONSEL, M.D.

The Surgical Treatment of Osteoarthritis of the Hip Joint Herman G. Gado *Acta chir scand.*, 1947 95 Supp 120.

This monograph is based on clinical observations during and after operative treatment of 123 osteoarthritic hip joints. There were 115 patients on whom 130 operations were performed during the period from 1938 to 1946. The operations were listed as follows:

- 15 capsular extirpations as an independent intervention
- 14 arthroplasties with Smith Petersen vitalium cap
- 49 arthroplasties with vitalium cap and capsule extirpation
- 7 arthroplastic resections
- 12 shelf operations
- 6 acetabuloplasties
- 27 arthrodeses
- 3 drillings and bone transplantations to the head or neck of the femur

INTERNATIONAL ABSTRACTS OF SURGERY

Three patients (3.3%) died. The causes of death were pulmonary embolism, fat embolism and paralytic ileus 1 case of each. Two patients died subsequently of intercurrent disease. Of the 115 patients 44 were men and 71 were women. The average age was 45.5 years. The affection was unilateral in 50.8 per cent and bilateral in 49.13 per cent. Of the 123 hip joints operated upon for osteoarthritis, 47.9 per cent presented congenital dysplasia of the hip joint. In 14.5 per cent the etiology was unknown. In the remainder of the cases the affection had developed on the basis of trauma, epiphyseolysis Legg-Calve Perthes disease, aseptic necrosis and nonspecific arthritis. Cases of osteoarthritis which developed on the basis of chronic polyarthritis were not included.

Capsule extirpation as performed by the author is indicated in the earlier cases before there is great deformity of the joint surfaces. The degree of excision of articular cartilage seems to play a less significant role for the immediate therapeutic result. The operation is contraindicated in the cases in which there is subluxation or a tendency thereto. Thus operation is not suitable for very old or very debilitated patients.

The technique employed by the author in his capsule extirpation operation is essentially that of Smith-Petersen. The incision is carried farther backward in order to facilitate the excision of the posterior portion of the capsule. The muscles are detached from the ala illi extraperitoneally in order to decrease undesirable new bone formation. The tendon of the rectus is retracted while the hip is held in 30 to 45 degrees of flexion. In difficult approaches the tendon is sectioned. The fibrous capsule is separated from the overlying muscles. This may be accomplished largely by blunt dissection. The capsule is then detached from the acetabulum and downward toward the neck, but a collar of capsule is permitted to remain on the neck in order to preserve the blood supply. When as much of the capsule as possible has been removed through this anterior approach the head of the femur is dislocated from the acetabulum by adduction and external rotation. A strap traction the remaining portion of the capsule is placed around the neck of the femur and by lateral thrust. Protruding bony excrescences are resected. The head is replaced in the acetabulum. The gluteal fascia is securely reattached to the iliac crest. A drain is used for 24 hours to prevent hematoma formation. After the operation the extremity is placed in semiflexion and slight abduction over a large pillow. After a week, passive and active motion of the hip joint is begun, and at the end of the second week the patient is up and about on crutches.

The technique of vitallium cap arthroplasty described by the author is similar to that of Smith-Petersen arthroplasty. Grade of articular cartilage as possible deeper type of cap is preferred. Once active movements of the operation started under the supervision of a

therapist. The first 4 to 6 weeks are the most important in re-establishing movement. The exercises no complicated suspension or traction apparatus. Exercises are continued for more than a year postoperatively. The patients are taught to walk correctly.

DANIEL H. LAVERGNE, M.D.

The Technique in Transarticular Nailing Arthrodesis of the Hip-Joint. Hugo Aronson, *Ann. Surg.* 1947 95 475.

The author suggests a technique for transarticular arthrodesis of the hip joint. The problem of obtaining a satisfactory end result and the complications which have been reported by other authors are discussed. The most common complications are (1) extrusion of the nail (2) subtrochanteric fracture of the femur (3) diastasis in the joint, and (4) failure to drive the nail home. The author suggests that with careful technique attention to detail, and the use of a Smith Petersen three flanged head and the transverse screw through a rotatable head the desired excellent end results will be attained. It is suggested that with the aid of a Bahr's three-rod chisel, the nail can be easily and neatly driven in without the risk of producing a subtrochanteric fracture of the femur.

Two figures showing roentgenograms of these pins in place and 5 additional figures showing the preparatory drill, V. Bahr's three-rod chisel as the instrument for nail extraction are shown.

RICHARD J. BENNETT, JR., M.D.

FRACTURES AND DISLOCATIONS

Effects of Thrombin Injection into Hematomas Enveloping Fractures of Humerus in Rabbits. E. P. Lasher and G. B. O'Neill. *Archives* 1947 40 36.

An experimental study was made on male rabbits in which the right humerus was broken in a metal clamp. An hour later 1,000 Iowa units of thrombin in 5% c.c. of saline solution were injected along the fragment ends. In one-half of the animals. The Gross and microscopic figures are presented of these lesions at 12 days, 30 days and 35 days. The authors believe that there is suggestive evidence that the local injection of thrombin into the fracture area limits excessive bleeding and results in a more orderly and perhaps more rapid repair of the injury. And that, by inducing early clotting of the blood surrounding the fragments does not impede the eventual restoration of bone continually.

RICHARD J. BENNETT, JR., M.D.

studies of biopsies, the effects of the blood type and Rh factor and the methods used in the preservation and storing of bone. Regeneration in bone grafting takes place only when the grafts are in contact with living bone. Age is important in that grafts have proved to be more successful in the young than in the aged.

Cortical bone is believed best for stability while cancellous bone is preferred for osteogenesis. The blood type has been shown to have no influence on the successful use of homogenous grafts of bone, nor does the Rh factor influence transplantation results. Homogenous bone grafts were used in 67 operations with but 4 complications.

METHOD OF USING AND STORING BONE

1 *Direct or immediate grafting* Bone may be obtained from other patients upon whom operations are being performed simultaneously or from relatives who are admitted to the hospital for this purpose. It may be transferred directly from the donor to the recipient. This method of transfer was used in 15 instances for homografts and in 9 instances for syngeneic grafts.

2 *Delayed grafting* This type of grafting whether autogenous or homogenous, is the storing of bone in the tissues of a patient for use in secondary operations. This method has been used successfully on several occasions, but should rarely be necessary in institutions where a method of keeping a supply of bone in a bank has been instituted.

3 *Refrigeration* This is a convenient method of preservation. For tissue to be used in the human being the temperature and duration of storage are

important. Two methods of refrigeration have been used in the New York Orthopedic Hospital. In regular refrigeration bone may be stored at $+2$ to $+5$ C for periods up to 3 weeks. It is stored under sterile conditions in a glass screwtop container which is placed within a similar larger bottle. The second method is deep freezing at -25 C. The method has been tested experimentally on rabbits and used in 30 human cases. With both types of refrigeration the bone is warmed to room temperature before it is used. Bone which has been preserved under these conditions has the appearance of fresh bone. Homogenous bone grafts have been used in 67 operations performed on 50 patients, with bone from 73 donors. Syngeneic grafts were used in 9 children in operations for congenital pseudarthrosis osteogenesis imperfecta, and large bone cysts. The excellent results obtained in this entire series of patients as well as the minimum complications experienced, have been very encouraging.

Excess bone removed from the ilium during such operations as arthroplasties and fusions of the hip as well as bone from the tibia and from other sources, is placed in the bank. Prior to storage the bone is cleaned. It is cut into small pieces when used. All suitable bone is collected and placed in the deep freezer for future use. The ilium is the best and largest source of cancellous bone the tibia of cortical bone. Homogenous bone may be obtained in large quantities in the future from cases in which trauma has been the cause of death. The bone should be collected and stored immediately after death and the necessary precautions regarding sterility should be observed.

C. FRED GOETTMACHER, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Phlebography for the Study of Obstruction of the Veins of the Superior Vena Caval System. Sol Katz, Hugh Hudson Husey and James Ross Veal. *Am J M Sc* 947 47

The authors note that phlebography, by providing roentgen visualization of the veins, offers a method unequalled by other techniques for defining and localizing lesions of the veins and determining the distribution of the collateral circulation. This method has been used mainly in connection with thrombosis of the veins of the lower extremity. Its importance in similar lesions of the veins of the superior vena caval system has not been emphasized. There has been no report made prior to this which offers a full appraisal of the value and limitations of phlebography in cases of obstruction of the superior vena cava and its main tributaries.

In the present contribution, it is the purpose of the authors to present cases which are illustrative of their experience in lesions of this type and which provide adequate testimony to the value of phlebography as a means for precise diagnosis.

The technique of phlebography in the superior vena caval system is described and a number of case reports are presented. Phlebography provides anatomic details that otherwise could be obtained only by dissection. There is no other means to differentiate clinically obstruction of both innominate veins from occlusion of the superior vena cava, or axillary vein thrombosis from obstruction of the subclavian vein. There is no more accurate method for the study of the development and extent of the collateral venous circulation. Phlebography of this type is very simple, no special apparatus is necessary, and the technique requires only the skill ordinarily employed in a venipuncture. Diodrast is used as the contrast medium and it is believed by the authors, to be almost entirely safe. However it is advised that tests for hypersensitivity of the patient to the drug be per-

The Surgical Pursuit and Removal of a Metallic Foreign Body from the Systemic Venous Circulation. W W Davey and G E Parker *Br J Surg* 1947 34-392.

An unusual case is presented, in which a shell fragment was pursued through the systemic venous circulation and ultimately removed successfully. The patient, aged 19, sustained a shell wound in the left clavicular region. At operation, a small metallic foreign body was removed. Subsequent x-rays revealed the presence of another metallic foreign body in the upper anterior mediastinum. Because of the presence of retrosternal pain, evening temperature elevation, and the possibility of abscess formation or secondary hemorrhage, a second operation was performed. A C-shaped incision was made exposing the second and third left costal cartilages and sternum at that level. The foreign body was felt in the left innominate vein and during the operative manipulation it became dislodged and moved toward the heart. Immediate x-ray examination revealed the fragment to be lying in the right auricle. The operation was continued 1 hour later at which time the pericardium was exposed through a reversed C-shaped incision which incorporated the lower limit of the first incision. The foreign body was felt in the intrapericardial portion of the inferior vena cava. Attempt at removal with a pair of forceps introduced into the auricle was unsuccessful, and immediately following this manipulation the fragment passed down the inferior vena cava to the right common iliac vein. Since there was danger that the foreign body might be drawn back into the heart during coughing or postoperative vomiting, when pressure in the great veins is negative, immediate reoperation was decided upon. Through an oblique extraperitoneal incision parallel to the inguinal ligament, the vein was tied off proximally and the fragment removed. It proved to be a jagged shell fragment, 1 by 1/4 by 1/4 inches.

years, and he is leading a normal life working as a technician in technicolor.

The authors review the literature and present several somewhat similar cases which have been described. They mention Warthen's work on dogs in which he introduced metallic foreign bodies into their veins. In all cases they were carried toward the heart. This occurred in hours or days but the heart was reached, irrespective of gravity or the dog's position. Upon reaching the heart the smaller bodies tended to remain in the right ventricle at the base of the chordae tendinae while the larger ones were carried through to the lungs.

It appears clinically and experimentally that the usual course of a foreign body in the venous system is toward the heart. This tendency can be reversed or impeded by gravity or coughing at which time a reverse wave of pressure is conducted in the inferior vena cava, distally. Free movement of foreign bodies in the inferior and superior venae cavae occurs because of the absence of valves. The foreign body must be prevented from entering the right ventricle because then according to the reported cases death usually occurs. In the attempt to remove a foreign body in close apposition to a great vein it should be trapped if possible by proximal occlusion of the lumen so that the risk of transmission to the heart is eliminated.

ROBERT A. NARATOFF M D

Absorbable Fibrin Tubes for Vein Anastomoses.
Orvar Swenson and Robert E. Gross. *Surgery*
1947 32: 137

The authors note that until the advent of aseptic surgery substantial progress was not made in the field of vascular anastomoses. The most successful methods of restoring continuity in blood vessels may be divided into two general groups: (1) by careful direct suture, and (2) by the use of mechanical devices. In spite of the greatest care with the suture technique thrombosis is a common cause of failure to produce a satisfactory anastomosis.

Various mechanical devices have been used for uniting blood vessels more quickly and more successfully than the suture technique. The history of the use of these and the objections to their use are reviewed by the authors. When the magnesium ring is used, a highly basic salt results and provokes violent tissue reaction. Rigid tubes made of vitallium excite little tissue response. In adults the use of a vitallium tube has provided a satisfactory method for making blood vessel anastomoses. In children this method has certain limitations because the vein lumen at the anastomosis cannot possibly increase in size because of the rigid tube.

Because of this limitation the authors sought for material which (1) would be sufficiently rigid (2) would cause little reaction in animal or human tissues, and (3) would be absorbed by the host in a matter of several weeks or months. Fibrin film was found to be a material that gave a minimum of tissue reaction and was completely absorbed in from 6 to 8 weeks when used in monkeys and human beings.

The investigation reported upon by the authors was made during and after vascular anastomoses with plasticized fibrin cuffs to aid in vein reconstruction by a nonsuture technique. The method of the preparation of fibrin film is discussed and the technique of its use is described. Dogs were used in all of the experiments. The abdominal vena cava or a jugular vein was employed for the various anastomoses. Twenty-seven anastomoses of the veins were made, removed and examined later. Thrombosis had not occurred in any instance. When the vessel was opened the intima was smooth and glistening and the precise line of anastomosis was often difficult to identify. Because of extensive regional infection a vena cava vessel had become obliterated by fibrosis.

In summary, a detailed description is given of the nonsuture method of vascular anastomosis used by the authors, wherein the vessel segments are brought together over a fibrin cuff to make an intima lined reconstruction. The fibrin tubes disappear usually in 6 or 7 weeks. This leaves an anastomosis which is adequate in size, which is not constricted by a metallic ring and which can enlarge in diameter with any subsequent growth of the individual.

HERBERT F. THURSTON M D

Conservation of the Arterial Channel in the Treatment of Arteriovenous Aneurysms (De la conservation de la voie artérielle dans le traitement des anévrismes artério-veineux) René Le Riche. *Lyon Chir.* 1947 43: 139.

The idea of endaneurysmorrhaphy first suggested by Matas has given rise to the present day concept of preserving the arterial channel in the treatment of arteriovenous aneurysms. If the fistula is a narrow tract, it is simple to close each orifice with a suture and cut the fistulous tract. Usually the artery and vein are adherent for some distance proximal and distal to the opening. This makes it necessary to select one of several alternative procedures such as the following:

1. Separation of the union of the vessels and lateral suture of the artery and vein. This is theoretically the ideal procedure since the integrity of the circulation is re-established.

2. Lateral suture of the artery and sacrifice of the vein. This procedure may be carried out when the fistula is difficult to locate but when the vein is ligated the patient may be bothered by persistent edema.

3. Endovenous suture of the opening of the fistula. This is the original Matas-Blickham procedure. The author believes that it is useful chiefly in cases of carotid jugular aneurysm to avoid the danger of hemiplegia which may follow quadruple ligation. In the extremities he believes it is safer to free the artery above and below the fistula then dissect the sac sufficiently to separate the vessels and repair them individually.

4. Endarterial suture of the opening of the fistula. The author cites a single case reported by Robert

Danis (*Act Chir Belg* 1946 p 101) in which this procedure was carried out successfully for an arteriovenous fistula of Scarpa's triangle and the vein was completely covered by the artery.

5. Closure of two adjacent arterial segments by opening the vein and sacrificing it. One case of this type is described in which a small adjacent openings between the posterior tibial artery and vein were closed by transvenous suture. This type of procedure is put forth as preferable to quadruple ligation as the author believes the collateral circulation is poor in the foot. When an arteriovenous fistula has been present for some time the proximal portion of the artery becomes markedly dilated. If the artery is then excised or otherwise obliterated an ascending thrombosis in the dilated arterial tree may lead to gangrene. Thus when the vessels are dilated proximal to an arteriovenous fistula the re-establishment of the arterial continuity is absolutely necessary.

5. End to end suture of the artery and the vein with a graft after excision. This procedure is rarely indicated. Even when the artery itself contains a sac, the author prefers a direct repair of the artery or an endosaccular obliteration of the arterial orifices.

The aforementioned conservative procedures are possible only in the presence of perfect hemostasis. At the roots of the extremities complete hemostasis is to be obtained only by compression of the proximal subclavian artery for the upper extremity and of the aorta for the lower extremity.

When any procedure is performed in which the endothelium is sutured there seems to be a state of vasodilatation distal to the sutured area which stimulates sympathectomy without the anhidrosis which accompanies the latter.

THEODORE B. MAMMILL, M.D.

BLOOD; TRANSFUSION

Homologous Serum Jaundice. I Herbert Scheinberg, Thomas D Kinney and Charles A. Jaisway *J Am. M. Ass.* 1947 134 841

The authors are reporting the cases of homologous serum jaundice which were observed in the Peter Bent Brigham Hospital during the year ending August, 1945 to emphasize the importance of this disease and to discuss the problem of serum jaundice and possible methods for its prevention in the operation of a hospital blood bank. In the blood bank which has been run jointly by the Children's Hospital and the Peter Bent Brigham Hospital the blood is collected with the usual safeguards and precautions and stored in sodium citrate at 5 to 10 degrees C. At the end of about 7 days the red cells are discarded and the plasma from 10 to 15 bottles is combined to make a pool. Each pool is numbered, a sample cultured and a record made of the donors whose plasma it contains. The pool is then frozen and stored. When it is to be used the plasma is thawed at 37 degrees C. and divided into 250 c.c. units.

The criteria used in selecting cases of homologous serum jaundice for this report were (1) each patient

had received plasma or blood or both between 34 and 135 days before the onset of jaundice (2) the clinical observations were characteristic of acute hepatitis, and (3) in the fatal cases the pathologic findings were those of fatal hepatitis. Thirteen cases are reported in detail 3 with definite homologous serum jaundice 3 questionable cases, 3 other fatal ones, and 5 other nonfatal cases. As an example, pool Ks 119 is cited in which 7 of 9 individuals given transfusions developed this condition.

It is emphasized that there is no diagnostic test which will differentiate between homologous serum jaundice and infectious hepatitis. The criteria which were used suggest that the former diagnosis is correct but does not prove that the disease was not infectious hepatitis. Also most of these patients were over 30 years of age whereas infectious hepatitis usually occurs in younger persons. In considering pool No. 119, which is cited specifically they investigated the 15 donors for the source of the ieterogenic agent. Twelve gave negative responses. One had confirmed diagnosis of congenital hemolytic icterus, 1 had had jaundice 3 years before, and 1 just before donation of blood reported loss of appetite, nausea, soreness in the right thoracic region just at the last rib, yellow stools, easy fatigability and nervousness. Either of the latter 3 could have been the source. Two patients died of their original disease before sufficient time had elapsed to permit them to contract serum jaundice. Thus 11 cases are chosen as examples of homologous serum jaundice if 3 months is assumed to be the average incubation period of homologous serum jaundice. This study occurred over a period of 1 year. During this period 1,404 units of blood and 949 units of plasma were given to patients in the hospital, and a minimum incidence of the disease could therefore be 1 in every 333 transfusions. It is probable that as a result of the pooling procedure plasma is much more apt to produce jaundice than is whole blood. The minimum incidence would be 1 in every 86 transfusions of plasma if all these cases resulted from plasma. Detection as to the source is extremely complex when a patient has received multiple transfusions involving a large number of donors. Lots of homologous blood products which are definitely ieterogenic vary greatly in the incidence of jaundice following their administration.

The mortality is variable. In the authors cases the mortality was 36 per cent, which they consider abnormally high.

In considering methods of control the authors believe that in the operation of the blood bank greater efforts should be made to detect the infectious donors, the practice of pooling plasma should be curtailed, and lots of plasma should be given to as few recipients as possible. They believe that the following should be excluded as donors. Any person who has (1) ever had jaundice or hepatitis (2) had contact with a person with jaundice in the past year (3) received human blood or its derivatives in the preceding year except products of plasma fractionation, (4) been a hospital patient in the past year (5) had

fever (6) icterus (7) an enlarged or tender liver or spleen or who has (8) bilirubinuria or hyperbilirubinemia.

The basis for condemning the practice of pooling plasma is the fact that the amount of infective serum necessary to produce the disease is incredibly small. They seem to believe that it would be desirable to give the plasma of one donor to only one recipient and no other and thus at least limit involvement to one individual. This would necessitate the requirement that plasma should be typed and crossmatched or treated with group specific substances.

Since the infective principle is extremely potent it is difficult to eliminate it by direct means. Plasma fractionation may be a possible means of elimination. Certainly attempts to treat the recipient preventively have been unsuccessful.

LEROY J. KLENGMAYER, M.D.

Peritoneal Irrigation in the Treatment of Renal Failure Due to Transfusion Reaction H. Cline Robertson and P. S. Rutherford. *J. Lab. Clin. M.* 1947 33: 583.

The reported successful use of peritoneal irrigation for the treatment of renal failure following the administration of sulfathiazole (Frank, Seligman and Fine) prompted the authors to employ a similar method in the treatment of a solitary case of severe renal damage following a blood transfusion reaction. In this instance peritoneal irrigation with Tyrode's solution produced an apparently beneficial effect on the uremic manifestations but the patient died of generalized edema. The authors suggested a modification of Tyrode's solution consisting of a reduction of chloride content with the view of preventing such fatal edema.

ROBERT TURELL, M.D.

LYMPH GLANDS AND LYMPHATIC VESSELS

Experimental Investigations in the Leucemias and the Tumors of the Reticuloendothelial System (Recherches expérimentales sur les leucémies et les tumeurs du système réticulo-endothélial) Maurice Guérin. *Rev. hemat.* 1947 3: 13.

A report is given on the author's experiments at the Cancer Institute of the University of Paris during the last 15 years.

1. Researches on fowl leucemia.

The first investigation was made of the fowl leucemia of Ellerman and Bang, an infectious disease transmitted by a filterable virus. Previously, tumors had been observed in the course of the development of this leucemia, but the reproduction of such sarcomas was inconstant and uncontrolled.

A transmissible erythroblastic leucemia was isolated which seemed capable also of affecting the myeloid and reticuloendothelial elements. Attempts to favor fixation on the reticuloendothelium were made by blocking with India ink or thorotrast by injecting infusorial earth which caused granulomas, and by increasing the virulence of the virus by repeated passage through young chicks. All these were

unsuccessful. However when the virus was attenuated by cold storage with or without glycerin, large numbers of sarcomatous tumors developed in the mesenchymal tissue elements at times even without concurrent leucemia. Histologically these tumors were fibrosarcomas. Some grew rapidly with multiple metastases and others were malignant only in their tendency to recur after excision. The average duration of the course of these tumors was from 1 to 4 months. In a few it was over a year. Some of the secondary tumors were true metastases in that they had the same histological structure as the primary neoplasms but in other cases the secondary growths were histologically new types such as pericardial endothelioma and intestinal myosarcoma. These were apparently not simple cellular emboli but represented a direct action of the virus in which the cytotropism had become modified. No definite epithelial neoplasms were demonstrated.

Working with other strains of hemotropic virus the author and other workers elsewhere have succeeded in producing sarcomas. In answer to the claim that he has been dealing with a mixture of two viruses, he points out:

a. The change in the tissue affinity of the virus is accompanied by a change in the type of leucemia produced.

b. When the virus is subjected to repeated passages through fowl the sarcomagenic power disappears only gradually and leaves the purely leucogenic action.

c. When chickens are immunized against leucemia the virus likewise fails to cause sarcoma, although such immunized animals are still susceptible to other types of sarcoma such as the Rous variety.

Attempts were also made to produce passive immunity by injecting fowl with blood elements or reticuloendothelial tissue suspensions taken from resistant animals. No immunity was produced. Active immunization was produced by progressively larger injections of attenuated virus. Various methods of causing attenuation were tried. The most effective technique for purposes of immunization seems to be the use of formalized leucemic blood incubated at 37° C for from 1 to 4 weeks.

The therapeutic effect of various quinine derivatives was investigated. The best response was obtained with rhodiquin (6 methoxy 8 diethylamino n propylamino quinolin) given in large doses by vein.

2. Tumors of the reticuloendothelial system.

Among 6,000 autopsies on rats the author found 9 cases of leucemia all in females generally of an advanced age. Six of these were lymphatic leucemia and 3 myelogenous leucemia. Of the latter 2 were of the chloroleucemia type characterized by a greenish blue of the kidney, the lymph nodes, and the bony tissues. Transmission experiments with these leucemias were rather unsuccessful except with the chloroleucemias one of which gave rise to a transplantable strain of rat chloroma. After 35 passages the tumor may give as high as 50 per cent of takes. It develops in the region of the implantation

varies in size and may give numerous metastases capable of involving all the organs. Its localization is analogous to human myeloma.

Also like the human affection this disease may be associated with a myelogenous leucemia in its advanced stages. The author likewise considers the green color similar to that of human 'green cancer' of Aran. The pigment exhibits intense red fluorescence under ultraviolet light. Spectroscopic analysis has confirmed the presence of protoporphyrin, but the concentration of the latter does not correlate with the intensity of the green color. Hence, there seems to be some relation between protoporphyrin and the green pigment, although the two substances are not identical.

Among 4,000 rat autopsies, 30 cases of spontaneous lymphosarcoma were observed. Two were of the lymphoblastoma or lymphocytoma type and the others were reticulum cell sarcomas. Implantation of the former was unsuccessful. Three of 7 implantation attempts were successful with the reticulum cell group. Two of the 3 were followed to the seventh and twentieth passage, respectively. Although of the same histological type, the two tumors showed considerable difference in degree of malignancy and sensitivity to roentgen irradiation. At no time did either tumor exhibit leucemic properties.

Among 3,000 mice the author collected 24 cases of reticuloendotheliosis, a growth which generally resembled a diffuse inflammatory granuloma of the reticuloendothelial system but at times manifested itself as a true neoplasm. The mouse disease is compared to certain human affections of the reticuloendothelial system which also seem intermediate between granulomas and true tumors. The author believes the human cases are infections rather than neoplastic since he injected blood from a human case in mice, rabbits and chickens and succeeded in producing two types of disturbance in mice: a paraplegic

syndrome and an abdominal syndrome with hepatomegalia. The spontaneous reticuloendotheliosis of mice were also shown to be transmissible with liver or brain pulp as the source of infection. While some of the infected mice developed a diffuse reticuloendotheliosis, others manifested subcutaneous sarcomas.

From these experiences it is concluded that mouse reticuloendotheliosis seems to be transmissible and in the course of its passage through different animals may undergo alteration from a purely inflammatory granuloma to a neoplasm of the sarcoma type. The etiological agent seems to be infectious but because of the relatively large filter used it has not been determined whether it is a virus or some larger entity such as a bacterium or a spirilla.

By exposing chickens to benzopyrene, leucemia and sarcomas were produced which resembled the spontaneous types but were not transmissible. In rats, sarcomas of the spleen were produced but these also could not be transplanted into other animals. However a histiocytic sarcoma of the liver caused by a benzopyrene implant was transplanted through 5 passages.

The author concludes as follows:

1. The intimate relationship between leucemia and the neoplastic process is apparent in the fact that the leucemic virus was able to cause a sarcoma in fowl, and in rats a myeloma developed from the leucemia. Furthermore, the cycle could be completed by the development of leucemia from these tumors.

2. The existence of the phenomenon of immunity has been clearly demonstrated in fowl leucemia.

3. The transition from inflammatory reticuloses to typical neoplasms such as sarcoma and leucemia has been established.

4. Tumors of the reticuloendothelial system and leucemia have been produced by synthetic chemicals.

THEODORE B. MAXWELL, M.D.

SURGICAL TECHNIQUE

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Digital Foreign Bodies in Spot Welders. W. A. B. Reynard and Frederick Smith. *Brit M J* 1947 1 843

The authors report 12 cases of foreign body in fingers to spot welders. In resistance welding or as it is more popularly known spot welding, two pieces of metal are joined together by a combination of mechanical pressure and the heat generated by the passage of an electrical current. Either a stationary machine to weld small objects or a mobile 'gun' for larger work, is employed in the process. In either type of work, as the current is flowing and the weld is being made, there may be a spraying out ward of sparks of red hot metallic particles. Although this 'splashing' is usually negligible, at some times it is quite appreciable. However it is harmless to an operator wearing adequate protective clothing. It is less likely to be harmful to the operator of a gun for he has to hold the device with one hand and control the flow of current with the other, thus keeping both hands at a safe distance from the site of the weld. Not so with the operator of a machine for such a worker may have his hands close to the electrode to hold the object being welded and change its position from time to time. The worker's fingers are thus exposed to a concentrated discharge of fine metallic sparks travelling at nearly maximum velocity. In the series of cases reported 12 employees all operators of welding machines had multiple fine metallic fragments driven into their fingers.

Essentially these injuries consisted of superficial burns, minute entrance wounds and underlying foreign bodies. The red hot sparks were sterile but carried bacteria and dirt from the skin into the soft tissues, also they coagulated the immediately surrounding tissue and thus set up a medium for the growth of bacteria. The symptoms were primarily those of a burn and later those of retained foreign bodies with chronic inflammation. In no case was there any injury to tendon, bone, joint or nerve. Fortunately the lesions were all localized to the pulp of the fingers. Even such involvement was quite painful and even disabling, especially when there was pressure on the nerve fibrils in the finger tips.

Some of the patients did not report for treatment within the 12 hour period considered safe for primary surgical care. Treatment of their wounds was limited to the application of poultices, incision of small abscesses, excision of necrotic tissue and removal of the small metallic fragments. When the wounds can be treated early the authors advocate thorough débridement under local block of the digital nerves or a general anesthetic through a bloodless field secured by a finger tourniquet with subsequent primary suture. They favor the use of an electromagnet for

more complete removal of the minute metal particles.

The most feasible prophylactic measure appears to be the wearing of protective gloves. Cotton gloves coated with neoprene or asbestos finger stalls worn under the usual cotton gloves have been the most satisfactory to date.

BENJAMIN F. LOVINSKY, M.D.

Infection Caused by *Streptobacillus Moniliformis* Lawrence Kilham. *J England J M* 1947 236 969.

The author reports 2 cases of infection with the streptobacillus moniliformis following rat bites. Typically such infection is characterized by fever, migrating polyarthritides, a skin rash and a relapsing course. Usually a history can be elicited of a rat bite sustained within the preceding 10 days. In the first case that of a 5 month old infant bitten about the face and hand, the causative organism was cultured directly from the wounds and from the blood drawn on admission. However no skin rash or polyarthritides developed, and the wounds healed well despite osteomyelitis of the underlying bones of the hand. Treatment of this case which occurred early in 1940 was apparently symptomatic and largely directed toward good surgical care of the wounds.

The second case was that of a 75 year old man. Three days prior to admission he had been bitten on the forehead. On the day of admission he had fever, chilly sensations, headaches, backache and pains in the knees. The small head wound had healed, and he had no skin rash or evident arthritis. Penicillin was started immediately—40,000 units every 3 hours. Within 1 day the patient had become asymptomatic and within 3 days he was afebrile. Blood drawn on admission and cultured in a meat infusion broth showed within 24 hours the fluffy ball appearance characteristic of colonies of *Streptobacillus moniliformis* and pleomorphic gram negative organisms on smear. Agglutination tests employing the patient's organisms were strongly positive. When the patient's organisms were run against his own serum a marked rise in titer of immune bodies was demonstrated. 10 days after the onset of the disease it was 1:160 and 24 days later it was 1:320. After considerable study Brown and Nunemaker concluded that a titer of 1:80 is diagnostic of infection with the *Streptobacillus moniliformis*.

The author discusses the methods of culturing the organism and points out that the term "rat bite fever" covers 2 separate infections, the one caused by *Streptobacillus moniliformis* and the other by *S. minus*. They may be clinically indistinguishable but both respond well to penicillin therapy. Although the cases reported do not illustrate this fact, one of the outstanding characteristics of infections caused by *Streptobacillus moniliformis* is their pre-

dilation for the synovial membranes with the production of migrating polyarthrititis.

BENJAMIN F. LOEWENBERG, M.D.

The Spontaneous Occurrence of New Bacterial Infections during the Course of Treatment with Streptomycin or Penicillin. Louis Weinstein. *Am J M Sc.*, 1947 214 56.

Five cases have been described in which, during the course of specific antibiotic therapy there developed new infections due to organisms that were not susceptible to the agent with which the primary disease was treated. In 1 patient who probably had atypical virus pneumonia, the administration of penicillin resulted in an overgrowth of *Haemophilus influenzae* in the pharynx, followed by an invasion of the blood and respiratory tract. In another individual, treatment of faucial diphtheria was complicated by the occurrence of pneumonia due to the Friedländer bacillus. The 3 other cases were treated with streptomycin for *Haemophilus influenzae* infections: 1 of these developed bronchopneumonia with bacteremia, another meningitis with bacteremia, and the third recurrent pyelonephritis, all of the conditions being due to the hemolytic *Staphylococcus aureus*.

The mechanism by which this type of infection occurs is not completely clear. However in 4 of the patients there was a remarkable change in the bacterial flora in the nose and throat before new infection developed. Organisms that were apparently present in such small numbers that they were not detected early in the course of the disease increased in number after treatment with penicillin or streptomycin and invaded the tissues. That the new infections were not merely the result of numerical increase of one of the normal inhabitants of the nose and throat was shown by the fact that changes in the nasopharyngeal flora following the use of either antibiotic substance were frequently observed without a resultant new infection. It is possible that in some persons a high degree of bacterial antagonism exists in areas like the nasopharynx and that certain groups of bacteria are kept in check by others. So long as this normal relationship is not disturbed, the numbers and invasive ability of some of the organisms may be kept below a critical level when, however some of the bacteria are removed as a result of contact with an antibiotic agent of high specificity those organisms that are unaffected by the drug increase sharply in number and possibly in virulence. This phenomenon may be due entirely to an increase in numbers of bacteria if the micro-organisms are of sufficiently high virulence. These new infections were seen mainly in young children and in middle-aged adult who had had a serious infection and intoxication for 1 week before antibiotic therapy was started. Age therefore may be a determinant factor. Other factors that tend to produce lowered resistance such as chronic debilitating disease and senility may also be of importance.

The type of organisms normally present in the pharynx is dependent to some degree on the general

distribution of various bacteria in the population during certain seasons of the year. This will determine, in part, the organism that produces a new infection during the course of antibiotic therapy. In example in the summer season the carrier rate for *Haemophilus influenzae* is low and the chance that invasion by this organism will occur as a result of penicillin treatment is less than it is in the winter. The *Staphylococcus aureus* is present in the pharynx of most persons at all times, so that the seasonal factor probably plays only a minor role in the production of disease by this organism in patients who receive streptomycin.

The spontaneous occurrence of new infections due to penicillin-resistant organisms during the course of penicillin or streptomycin therapy raises the question of the use of either of these drugs in instances in which the exact bacteriologic diagnosis is unknown, because patients may be exposed to the added danger of superimposed bacterial disease without any benefit to the primary process. For example, the treatment of virus infections with either streptomycin or penicillin may be dangerous because these drugs have no effect on the primary disease and may allow organisms that are normally present on various tissues and are not susceptible to their activity to grow profusely and invade. The occurrence of this type of secondary infection is a strong argument for limiting the use of antibiotic agents to those cases in which bacterial disease is proved by isolation of the causative agent or to those in which the possibility of bacterial infection is very strong.

Although it might appear that the availability of such agents as streptomycin and penicillin has reduced the necessity for careful bacteriologic studies in patients with infectious diseases, the exact opposite is the case. The highly specific antibacterial activity of these drugs necessitates exact identification of the causative agents of the infections for which they are used, and the need for careful bacteriologic study is greater now than it was prior to the advent of the antibiotic substances. This applies not only to the period of the disease before treatment is started but also to the time during which therapy is being given, lest the manifestations of new infections of the type described in the cases reported be misinterpreted as due to failure of the original disease to respond to the drug being used. Frequent bacteriologic examination of the blood and of the nose and throat of patients who are being treated with an antibiotic agent even though they seem to be progressing well is to be highly recommended because a marked increase in numbers of an organism in the nasopharynx frequently precedes its invasion of the tissues by at least 24 hours. The discovery of a preponderance of *Haemophilus influenzae* or *Staphylococcus aureus* in the nasopharyngeal flora during the course of penicillin or streptomycin treatment should put the physician on guard for a complicating infection due to either of these organisms, particularly if the patient is a young child.

Since new infections may occur spontaneously during the administration of penicillin or streptomycin

in the question may be raised whether or not these 2 agents should be given simultaneously to patients who are particularly susceptible namely the very young or very old, or those with chronic debilitating disease. The combined use of the antibiotic drugs in shotgun fashion with the implication that bacteriologic examination is then not necessary can only be denied. Although each of these agents is on the whole, nontoxic, certain patients may become sensitized to them to the point where they cannot be used. Treatment with a combination of both drugs with an untoward sensitizing reaction may preclude the use of either agent some time later in the patient's life when his survival may depend on it. To advocate the employment of a combination of penicillin and streptomycin would result in even greater misuse of these drugs than they are at present subjected to and would only further their use in many diseases in which there is no infectious basis.

BENJAMIN GOLDMAN M.D.

ANESTHESIA

Neurological Complications After Spinal Anesthesia, and Results from 2,493 Follow Up Cases
Gunnar Thorsén. *Acta chir scand* 1947 95
Supp. 121

The purpose of this 272 page monograph has been to ascertain whether complications in the central nervous system occur immediately or later after spinal anesthesia. It submits spinal anesthesia to a critical review, analyzing the results arrived at as well as the risks and indications of the method. It attempts to systematize all spinal anesthesia injuries to the central nervous system and discusses the mechanism of these injuries. The work is based on 2,493 questionnaires filled in by patients subjected to spinal anesthesia, as well as on 100 similar forms answered by patients who have undergone only lumbar puncture. The main part of the material has been obtained from the surgical department of the Central Hospital in Örebro, Sweden. Also a compilation has been made of cases from the literature with complications in the central nervous system after spinal anesthesia. In addition supplementary examinations and experiments on subject material have been performed. Only 2 anesthetics were employed in the interrogated cases viz. percain 1/15,000 or novocaine in the form of a substance or in 5 per cent solution. In addition pontocaine was used in a few cases. Cases with positive Wassermann tests were excluded. The questionnaires were sent out during 1940 up to and including 1943 to 3,375 patients who had been given spinal anesthesia from 6 to 18 months before and in 1945 to 120 patients submitted to lumbar puncture during the previous year.

The types of complications have been distributed in the following way:

1 Injuries localized in the cerebral region. These include headache dizziness disturbed vision uncharacteristic symptoms with possible cerebral cause

manifest cerebral injuries occurring in direct or in close connection with spinal anesthesia or occurring after an interval free from surgery and mental disturbances

2 Injuries localized to the medulla and its covering parts due to trauma, infection or the anesthetic agent

3 Injuries having no connection with the spinal anesthesia.

The material disclosed

1 That complications of the central nervous system occur after spinal anesthesia with the technique employed nowadays

2 That these complications have a far higher frequency than is generally assumed

3 That certain special injury types can be distinguished in which the cases in each separate type show agreement as regards onset symptomatology and course

4 That animal experiments and clinical experience render likely the occurrence of certain mechanisms of origin with regard to these different injury types

5 That certain conclusions may be drawn regarding the prophylaxis and therapy of these injuries.

6 That more strict indications for the use of spinal anesthesia should be stipulated.

MARY KARY M.D.

An Examination of the Local Anesthetic Action of Some Synthetic Sweet Substances and Other Phenyl Alkyl Derivatives. Leroy Vandam and Austin Lamont. *Anesthesiology* 1947 8 390.

It had been observed that some synthetic sweet substances possess local anesthetic properties and the authors thought that such substances deserved further investigation for possible clinical application. The anesthetic activity of several phenyl alkyl derivatives was observed on the rabbit cornea and compared with that of cocaine but none of these compounds proved to be as efficient as cocaine. In addition there were certain unsatisfactory characteristics with regard to solubility pH and color which might preclude the use of the drugs for clinical purposes.

MARY FRANCES POT, M.D.

Anesthesia Narcosis with Vinyl Chloride. Robert H. Oster, C. Jelleff Carr and John C. Krantz. *Anesthesiology* 1947 8 359.

Vinyl chloride gas an industrial chemical has been studied as an anesthetic in the dog. These observations conform to previous data which show that there is little difference in potency between the saturated and the unsaturated analogues, and actually ethyl chloride appears to be the more potent. The anesthetic syndrome is marked by incoordinated muscular activity in the extremities. The recovery period was prompt but accompanied by violent excitation. All of the animals manifested marked changes in cardiac rhythm in surgical anesthesia. These cardiac arrhythmias were of a serious nature

It is the opinion of the authors that as an anesthetic in the dog, vinyl chloride is unsafe and that its use in man is unwarranted.

MARY FRANCES POZ, M.D.

Neurophysiology of Respiration during Surgical Anesthesia. Pneumographic Studies on the Human Being during Intravenous (Pentothal), Ether and Spinal Anesthesia. James C. McCann. *Current Res. Anesth.*, 947 26 89, 140.

These studies have evolved the picture of a complete neurospecific pattern for reflex stimulation of respiratory centers during surgery. Respiratory response to surgical trauma has been demonstrated to be segmentally neurospecific and to occur whatever the anesthetic agent used. In general selective reflex stimulation of either inspiratory or expiratory neurons and intensity of response are directly related to the neurologic segment as well as to the autonomic plane or the structures within which the stimulus is originated.

Reflex response of these accessory muscles of respiration is of both a tonic and a superimposed rhythmic type of contraction. The first is completely independent of and dissociated from the rhythmic respiratory cycle. The second type is a succession of intermittent rhythmic, forceful contractions of accessory muscles during the expiratory phase of respiration. There may be a tonic contraction of accessory muscles of respiration during the induction phase of anesthesia and also as a reflex response to surgical trauma.

The intensity of respiratory response to trauma reveals an increased gradient of activity from the periphery of the body toward the central zone. This is true in both somatic and visceral planes. Reflex response of respiration to trauma as noted in these studies is dependent on stimulation of the end organs which lie in relation to nerve endings in areas having representation of nerves from specific neurologic segments.

Noxious impulses initiated by the trauma of surgery are conducted centrally over two distinct afferent sensory nerve fibers—the somatic and the visceral. This review has outlined the tract of afferent pain conducting fibers from the somatic and visceral regions into the medulla oblongata, but they come into proximity with the respiratory center which results in reflex activation of the respiratory mechanism. Alterations in respiration induced by surgical pain impulses initiated either in somatic or visceral regions represent, undoubtedly, reflex phenomena produced by complex circuits between the center and peripheral areas. These reflexes must be based on rather complex circuits to account for the variable responses.

Pneumographic studies of respiration during surgical procedures on the human being in all portions of the body are presented to demonstrate the essential character of the response. The pattern can be rationally integrated with the existing bodies of anatomic, physiologic, and clinical facts. Its importance is that it constitutes essentially the physiology of surgical anesthesia. MARY FRANCES POZ, M.D.

PHYSICO-CHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Diagnostic Value of Tomographic Exploration in Surgery of the Spine (Exploration tomographique du rachis sa valeur diagnostique en chirurgie) Herdner *Rev. orthop. Par.*, 1947 33 341

Following a brief discussion of the advantages of tomography as a supplement to roentgenography in the diagnosis of certain lung conditions the author emphasizes the value of tomography in diagnosis of surgical lesions of the spine. He compares roentgenographic and tomographic findings in the cervical dorsal and lumbar spine. It is now his custom to make a preliminary x-ray examination, to be followed, when indicated by a tomographic analysis for dissection of the region and a minute analysis to overcome the inadequacy of the preliminary roentgen findings.

If pain is located in the medial or inferior apophyses of the cervical spine an analysis of the cervical spine as a whole in a series of 3 sections (median right, and left lateral (all anteroposterior and parallel) will suffice. The results obtained will resemble those seen after dividing the cervical trunk into 3 sections by 2 cuts along the flanks of the vertebral bodies, 1 slice including only the vertebral bodies and spinous apophyses the 2 other slices including the lateral apophyses. Paramedian sections very close to the sagittal plane will show the details of the walls of the spinal canal. Tomography has the advantage over roentgenography in that it reveals intrasections which are indispensable for early diagnosis in the dorsolumbar section but also of interest in the cervical segment. Lateral sections reveal only pedicles, transverse apophyses and articular apophyses on the same side. Tomography shows that interarticular lines may on occasion be fan shaped. A tomogram is shown with destruction of the interarticular line between the axial apophyses and the subjacent vertebra, in a case of arthritis sicca following fracture of the odontoid caused by a fall.

The superiority of the tomographic method is most clearly demonstrated in diagnosis of suboccipital lesions. The occipital condyles can be clearly demonstrated without occipital or maxillofacial obstacle. Also, the lateral masses of the atlas the occipitoatoid interlines and the lateral atloido-odontoid articulations can be seen. The occipital condyles will show even more clearly with greater flexion of the head. The occipitoatoid articular facets are only partially visible and tomography alone would therefore not suffice for a diagnosis of suboccipital Pott's disease. Special anteroposterior paramedian sections will show the entire length of the right or left articular facets.

Sagittal section completely separates the odontoid from the masses of the atlas which mask it and shows clearly the atloido-odontoid articulation. It

also exposes the body of the axis and shows the spinal canal. Parasagittal sections 17 to 20 mm. outside the preceding section permit complete isolation of the lateral mass of the atlas. A study of the occipitoatoid interline and lateral view of the occipital condyle is of special value in the early diagnosis of suboccipital Pott's disease. The technique of this procedure is described. The revelation of the occipitoatoid interline is one of the most valuable contributions of methodical tomographic analysis. Rigid technique quick intelligent assistants and perfect apparatus are needed for successful tomography. With these adjuncts tomography can be practiced successfully even on children under 10 years of age.

Horizontal sections reveal the spinal canal encircled by a vertebral ring at various levels. In the highest section the occipital trough can be seen between the mastoids the pneumatization of the latter being especially clear. A section some millimeters below this shows the atlas from above with the grooves of the vertebral arteries and their passage over the upper surface of the posterior arch. Only horizontal sections will show the anterior or posterior arches of the atlas in their entirety. Thus the spinal canal can be explored from one level to another. For accurate diagnosis it is necessary to see and this is possible only by this method.

The disadvantages of roentgenography in the diagnosis of conditions of the dorsal and lumbosacral spine are discussed. Tomography in the dorsal region constitutes only a variant of pulmonary stratigraphy. Because the method is simple and indispensable for correct diagnosis, it is now done as a routine in completing all dorsospinal examinations. Only scoliosis with its confusing projections is a contraindication. An analytical study of fine sections cut optically in the vertebra permits separation of the dorsal segment into its diverse elements. Thus a median section will reveal the point of complementary ossification of the spinal apophyses, a detail rarely observed in the roentgenogram. The first lateral section isolates the articular pedicles and apophyses on one side only and the second more external lateral section reveals the transverse apophyses and vertebral extremities of the ribs. Thus for all levels of the spine tomography permits two types of section, i.e. those of dissection showing the general morphology and those of intrasection exposing the interior of the bone. In a case of Pott's disease in which the carious focus as seen in the roentgenogram was masked by bronchial markings tomography permitted demonstration of the location and extent of the caries. Tomography has also been of aid in demonstrating vertebral metastases in cases with negative roentgenologic findings. Tomography was found useful in detecting foci of osteoarticular tuberculosis and is the only method permitting correct projection in profile of the first dorsal vertebra. Even

a faint tomogram yields more information than an excellent roentgenogram, and in some cases severe lesions invisible in the roentgenogram have been detected by tomography. In the lumbar spine a central caries in the massive vertebrae of this region may be undemonstrable except by tomography. Intestinal gas shadows can also be differentiated. In latent, painless Pott's disease tomography may be the only possible means of diagnosis. In the sacral region, the tomogram will show clearly the sacral grooves and the continuity between the sacral canal and the anterior sacral grooves. Anteroposterior sections serve for a detailed analysis of the sacral alae.

EDITH SCHWARTZ MOORE.

Preoperative Roentgen Treatment in Breast Cancer Sigvard Kase. *Acta radiol. Stockh.* 947 8 53

Surgery still remains the choice method of treatment in carcinoma of the breast. The role of preoperative and postoperative radiation therapy has fluctuated with the years, and during the past few years the Memorial Hospital group has completely eliminated the preoperative course of irradiation.

The results with various forms of treatment seem to be a matter of statistics. Consequently, it is rather difficult to compare them. Despite this fact the author has attempted an analysis of 301 cases of breast carcinoma treated from 1931 to 1943.

All cases were histologically proved carcinoma and were either classified as stage I or II. In stage I the lesion was confined to the breast, and in stage II the axilla was involved either clinically or confirmed by surgery.

Five year survival statistics were compared with those of Pack and Livingston who used no irradiation. For both stages the survival rate was 49 per cent as against 40 per cent in the Pack and Livingston group. Harrington found that in the cases in which the Broder histological classification was stage III or IV the results were slightly better when irradiation supplemented the surgery.

An analysis of the frequency of local recurrence in the cicatrix and axilla 5 years following treatment revealed that it was less and was associated with a better 5 year survival rate.

On the basis of the studies made and a comparison of the results of various forms of therapy in breast carcinoma the author concludes that preoperative irradiation improves the 5 year survival.

MAURICE D. SACHS, M.D.

RADIUM

Cancer of the Cervix. Ira I. Kaplan and Rieva Roosh. *Am. J. Roentg.* 1947 57 659.

The authors report their method of treatment of 916 patients with cancer of the cervix over a period of 31 years at the Bellevue Hospital, New York, New York. Pathologically the lesions were of all types, the greatest number, however, being squamous cell (403) and the next largest group of lesions being of

the pleomorphic type (380). Irradiation was planned and outlined according to the extent, type and character of the local lesion. In most cases roentgen therapy preceded the local application of radium.

The roentgen therapy in all cases was 200 kilovolt high voltage rays, using 0.5 mm. or 1 mm. of copper or Thorium filter administered through four port fields, two anterior and two posterior giving 1,500 to 2,000 roentgens (measured in air) to each field. Following the completion of the roentgen therapy local radium therapy was administered with the use of a special ribbon colpostat. The usual total radium dose given was approximately 7,000 to 8,000 mgm.kt., 4500 mgm.kt. to the cervix and the balance to the uterus. Larger doses were given if the malignancy involved the cervical canal.

In 61 cases previous hysterectomy had been done. Late in 1938, with the publication of the League of Nations formula for grading cervical lesions, the cases were divided accordingly into four stages. Of the 916 patients treated 379 are alive 5 years or more and 60 are alive 10 years or more. Eight patients developed recurrence or metastases 7 or 8 years after treatment. In 34 cases classified as grade 4, 1 lived 8 years and 8 lived 4 years. In 331 cases treatment was not completed for various reasons. In 30 cases complicating conditions were encountered.

The authors believe that irradiation is the best method of treatment for cervical cancer in any stage but stage 1.

FRANK L. HUMBY, M.D.

MISCELLANEOUS

Retention of Radioactive Iodine in Thyroid Carcinomas: Histopathologic and Radioautographic Studies. F. W. Foote, R. F. Hill, A. F. Hocker and L. D. Marinelli. *Am. J. Roentg.* 947 58 7.

The authors present 19 cases of thyroid carcinoma in which tissue sections and radioautographs were prepared and studied following the use of radioactive iodine by mouth. Several of the 19 patients received large therapeutic doses of the 8 day isotope (I^{131}) but a large majority received tracer doses ranging from 500 to 1,500 microcuries.

The technique consisted of administering tracer or therapeutic doses of radioactive iodine as sodium iodide in water solution by mouth 24 to 48 hours before surgery. Blocks of tissue about 3 to 3 mm. in thickness of both cancerous and noncancerous tissue are prepared and are then placed against the emulsion surface of a photographic plate or roentgen film. Areas of darkening on the photographic film map out the distribution pattern of the radioactive material in the sections to be examined. This pattern can be effectively studied by comparing it with the stained section by means of low power microscopy. Multiple sections were used. This served as a useful control and check over artefacts. Enlargement of the transparencies and corresponding magnification of the tissue sections revealed the histologic distribution of the radioactive material.

In the 19 selected cases included in this study there were 10 in which the presence of radioactive material was detectable by means of radioautograph ic determinations. Five of these were examples of benign metastasizing struma. The remaining 5 had the structure of follicular adenocarcinoma in some portion of the material studied.

From the foregoing it is clear that certain types of thyroid carcinoma do possess the ability to accumulate radioactive iodine. Furthermore it appears that structural type is an important determining factor. The pickup of the radioactive material is closely linked with structural qualities which include orderly cell arrangement in follicular pattern and the presence of colloidlike material. It is evident that these morphologic factors hold true for metastatic as well as for primary tumors in this study. In some of the cases which yielded positive radioautographs, there were portions of tumor that gave no evidence of ability to pick up the isotope.

On the basis of present findings and the estimation of the relative frequency of the various types of thyroid carcinomas approximately 15 per cent of thyroid cancers may be expected to accumulate radioactive iodine in some degree. The most favorable histopathologic type of thyroid cancer is the so-called benign metastasizing struma. Nearly the same statement can be made in regard to orderly follicular thyroid carcinoma. It is apparent that despite the rather close relationship between histopathological pattern and radiiodine pick-up a clean cut decision on the advisability of palliative or curative radiiodine therapy cannot be made on the basis of a limited biopsy since such a specimen may not reveal the more favorable histopathologic patterns that may be present.

FRANK L. HUSKEY M.D.

Carcinoma of the Skin: Influence of Dosage on the Success of Treatment. Clayton H. Hale and George W. Holmes. *Radiology* 1947 48 563.

The authors attempt to evaluate the effect that a given number of roentgens delivered to a carcinoma of the skin had upon the success or failure of the treatment. By comparing the results in a large group of lesions each of which had been given a different dosage it was hoped that an optimum dose might become apparent. This established optimum dose should be of value in determining the proper roentgen dose for skin cancer. Approximately 1,500 cases of carcinoma of the skin were reviewed in the order in which they appeared on the hospital records between the years of 1933 and 1944 inclusive.

A total of 1,035 lesions were irradiated with roentgen rays and 387 were treated surgically. Histological examination of 630 patients in the total group showed epidermoid carcinoma in 183 and basal cell carcinoma in 447. In the remaining cases treatment was given without histological confirmation because the clinical appearance was characteristic of carcinoma of the skin. The dose of radiation varied from 1,200 to 6,000 roentgens measured in air. Of the 893

lesions receiving a single massive treatment 54 per cent were irradiated with 200 kilovolts, 0.25 mm. of copper filter, 20 cm. skin target distance and half value layer 0.6 mm. of copper while the other 46 per cent were treated with 100 kilovolts the half value layer of which was 1 mm. of aluminum.

A tabulation of the results of the single massive dose method of irradiation in carcinoma of the skin over the range of the various doses used showed that 1,200 to 1,800 roentgens gave only an 81 per cent chance of destroying the lesion. The administration of 1,900 to 2,200 roentgens did not offer better than an 85 per cent chance, while the delivery of 2,400 roentgens might raise the expectancy to 91 per cent. A constructed curve showed that a lesion was as likely to be destroyed with a range of 2,500 to 2,800 roentgens as with the delivery of 4,000 roentgens. In the group of cases studied therefore, approximately 3,700 roentgens may be considered the optimum dose since it produced as satisfactory results as higher dosages and at the same time might be expected to leave the irradiated area in better condition.

A comparison of the results obtained with multiple treatments within the period of 1 week and of those obtained by the massive single dose method indicates that 3,200 to 3,600 roentgens must be delivered by the former method to produce the same results as were obtained by 1,900 to 2,200 roentgens by the latter method. Approximately 4,500 roentgens delivered in multiple treatments within 1 week produced essentially the same results as 2,700 roentgens given at one time. This dosage (4,500 roentgens) is suggested therefore as the optimum dose to be delivered to a carcinoma of the skin when the fractionated method (within 1 week) is to be used.

FRANK L. HUSKEY M.D.

The Treatment of Cancer Charles L. Martin and Carleton Wright. *J Am M Ass.* 1947 134 861.

Cancer of the exposed surfaces of the skin and cancer of the mouth are of unusual interest to physicians in the Southern states because of their high incidence in this area. The treatment of these lesions is described by the authors.

Epidermoid carcinomas of the skin and lip which measure less than 2 cm. in diameter and show little or no infiltration are treated with superficial roentgen therapy. The treatment factors are 85 kilovolts, 5 milliamperes, a 16 cm. skin target distance and a filter of 0.5 mm. of aluminum. An appreciable margin of normal skin around the edges of the lesion is included in the treatment area. Daily doses of 1,100 roentgens (measured in air) are given for 4 or 5 days, the total being 4,400 to 5,500 roentgens. Well elevated portions of the tumor are removed electrosurgically before roentgen therapy. The reaction is usually severe and healing occurs in 6 to 8 weeks. At the present time large lesions are treated with divided doses of deep therapy. The factors are 200 kilovolts, 20 to 25 milliamperes, a skin target distance of 30 cm. and filters varying from 0.5 mm. of copper and 1 mm. of aluminum to 0.8 mm. of

tin 0.35 mm. of copper and 1 mm. of aluminum. Ports up to 15 cm. on a side have been used successfully.

For squamous cell carcinoma, a daily dose of 300 roentgens (measured in air) are administered (skipping Sunday) until a total of 3,600 roentgens have been given. The sequence of events is similar to that observed with superficial technique. It is also desirable to remove polypoid lesions electro-surgically.

For lesions in the mouth, interstitial radium needle technique is used. The needles are made of platinum and have a wall thickness of 0.5 to 0.6 mm. and contain approximately 0.5 mgm. of radium per centimeter of active length. The needles found most useful have active lengths of 0.5, 1.5, and 4 cm. In order that the dosage may be easily estimated the needles are always left in place for exactly 7 days.

Elevated tumors are flattened electro-surgically before treatment. In flat tumors, needles are inserted into the base of the layer of growing tissue in patterns designed to deliver not less than 6,000 roentgens to all the tumor cells. Rounded tumors are treated by inserting the needles in two or more theoretic layers placed one above another. Radium needles are preferred to radon implants. The reactions are severe. Healing requires from 6 to 8 weeks or even longer depending on the size of the lesion.

Carcinoma of the skin of the forehead, temples, cheeks and neck, regardless of size or histological structure may be treated successfully with Ir radiation. Tumors measuring less than 3 cm. in diameter are treated by the superficial roentgenologic technique. The larger tumors, if they are fairly superficial, are treated with the Coutard technique, and with radium needles if there is much infiltration.

Tumors of the eyelids are treated with superficial roentgenologic technique. A gold-brass shield is slipped under the lids. The tumor area and a rim of normal tissue are all that is exposed to radiation. Malignant tumors of the inner canthus may be treated in this manner when they are superficial. Deep indurations which extend well down into the orbits are treated with a layer of weak radium needles with active lengths of 1.5 cm. plunged into the inner portion of the orbit. Cancers of the bulbar conjunctiva respond well to superficial roentgenologic techniques. Small superficial carcinomas on the nose may be irradiated with superficial roentgenologic technique. Larger lesions, particularly those which invade cartilage are removed by surgical diathermy.

Carcinoma of the ear presents a similar problem. Small lesions respond well to superficial roentgenologic technique. In large carcinomas, the overlying portion of the auricle is removed and radium needles are inserted into the remaining layer of the involved tissues on the side of the head. Invasion of the auditory canal is handled by stitching small radium needles into the wall of the passage.

Superficial carcinomas of the lip, measuring less than 3 cm. in diameter are treated with superficial roentgenologic technique. Large tumors and those showing deep induration respond extremely well to layer radium needle technique. In the treatment of carcinoma of the tongue lesions on the lateral border and tip can be reduced to flat layers for radon needle implantation by surgical diathermy. Masses in the center of the tongue are treated by placing needles, with 1.5 cm. active lengths, vertically into the tumors. Primary cancers in the floor of the mouth are treated by placing a vertical row of the smallest needles along the inner edge of the gum and augmenting them with a few 1.5 cm. needles placed transversely under the tumor. Carcinoma of mucosa of the cheek are usually flat and lend themselves to the layer radium needle technique. Primary lesions on the anterior part of the pillar and soft palate are always flat and are easily implanted.

After needle implantations are carried out the patterns are studied with roentgenograms of the involved area. Incorrectly placed needles are easily changed to correct technical errors. Metastatic cervical lymph nodes are treated by using a combination of the layer radium needle technique and the Coutard technique given simultaneously. The doses are large and the reactions rather severe.

The absolute three year cure rate in an unselected group of patients with advanced cancer of the face, lip, mouth, and cervical nodes, treated with irradiation, was found to be approximately 35 per cent. The relative 3 year cure rate in a group of unselected advanced cases was above 40 per cent.

FRANK L. HOWETT, M.D.

Radioactive Phosphorus as an External Therapeutic Agent in Basal Cell Carcinomas, Warts, and Hemangiomas. Bertram V. A. Low Beer. *J. Roentg.* 94:7 58-4.

Attempts have been made to use beta radiation in the treatment of skin diseases since its discovery. Beta radiation is particularly suitable for the treatment of superficial skin lesions because it penetrates only a few millimeters of skin. The effect of the rays is similar to that of roentgen rays or gamma rays. Early work with beta radiation was difficult because of the limited supply of material and because the available sources did not give off pure beta radiation.

The discovery of artificial radioactivity has made available substances which radiate beta particles only. Radioactive phosphorus (P_{32}) is one such substance. Absorption measurements have shown that approximately 48 per cent of the radiation from P_{32} is absorbed in the first millimeter of water or tissue and the absorption is practically exponential. The studies reported on were started in 1941 and after an interruption of 1 year were resumed in 1943. The best method found for the application of P_{32} was by means of a piece of blotting paper of known dimensions soaked in a measured quantity of radioactive sodium phosphate solution and dried. Office type blotting paper 0.4 mm. thick and weighing 11

mgm. per square centimeter was used. This was cut to size to cover the lesion with a safety margin of from 0.3 to 1.0 cm. according to the type of lesion. When prepared and dried the blotting paper is secured in place with adhesive tape and left there until the desired exposure in microcurie hours per square centimeter is obtained. Thirty-four microcurie hours per square centimeter were determined as the threshold erythema dose.

During the period from March 1943 to October, 1945 301 skin lesions were treated by the external local application of P_{32} these were included in this report. Basal cell carcinoma (52) hyperkeratosis (36) verrucose hands (132) plantar warts (50) subungual warts (16) and hemangiomas (17) were treated. During the early stages of these studies the dosage of the radioactive phosphorus varied considerably among the cases treated. The reactions of these various doses were carefully observed and recorded and a pattern of dosage has now been established.

The purpose of this report is to demonstrate that radioactive phosphorus a pure beta radiator can be used satisfactorily in the treatment of superficial skin diseases.

S. A. PATTERSON M.D.

The Deposition of Radioactive Metals in Bone as a Potential Health Hazard Joseph G. Hamilton
D. Harold Copp and Dorothy J. Axelrod *Am J Roentg* 1947 58:10

The radioactive elements involved in nuclear fission present danger to those working in production plants and laboratories handling this material. With the probability of a nuclear chain reaction pile the amounts of radioactive materials involved would be many million times greater than anything encountered in the radium industry. Fortunately many of these radioactive products produced in this way have short half lives so that radioactive decay quickly

reduces their concentration. Certain isotopes however including those of strontium (Sr), yttrium (Y), cerium (Ce) and plutonium (Pu.) have such long lives that the contamination of the personnel handling them can be a serious problem because these elements are rapidly fixed in the skeleton and are eliminated at a very slow rate. The sensitive cells of the bone and the bone marrow are therefore exposed to toxic radiation. Studies were done on rats to investigate the factors concerned in the absorption and deposition of these elements, their chronic elimination and a possible mechanism for reducing the toxicity of the plutonium which is deposited in bone.

The first element studied was strontium. This was the only element in the group which was absorbed to any significant extent from the intestinal tract. It was found that young rats fed orally on a low calcium diet absorbed 15 times as much of this element as did adult rats on a high calcium diet and 4 times as much when the strontium was injected intraperitoneally. It was therefore felt that exposure to radiostrontium or radium should be restricted to adults and that a high level of calcium intake should be maintained.

In contrast, there appeared to be no significant difference in the behavior of plutonium, yttrium and cerium when these same two groups of rats were compared. Further studies showed that the retention of strontium was greatly reduced in phosphorus deficient animals. There was no significant effect observed with regard to the retention of plutonium, yttrium, or cerium. It was shown by radio autographs that strontium appeared to follow the path of calcium metabolism and was deposited only in the bone salt while the 3 other substances were laid down in the uncalcified organic matrix of the bone and appeared to be unrelated to calcium in behavior.

S. A. PATTERSON M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Myasthenia Gravis and Tumors of the Thymus; a Clinical and Anatomicopathologic Study (Miastenia gravis y tumores del timo estudio clinico y anatomicopatológico) Aquiles Salvador Lentino. *Sem. med., B. Air* 1947 54 533

This treatise demonstrates the clinical and anatomicopathologic relationship of myasthenia gravis to certain abnormalities of the thymus. These are grouped under 3 headings: (1) a persistent thymus or subinvolution of the thymus; (2) hyperplasia of the thymus which consists of a quantitative as well as a qualitative increase in elements of the thymus; and (3) neoplasms or thymic tumors. The last are encapsulated and show epithelial hyperplasia. It is difficult to differentiate many cases from a simple increase in substance and adenoma formation. Histologically the tumors are thymocytomas, thymopitheliomas, or mixed tumors.

A detailed analysis of 5 cases is presented in which biopsy or autopsy section was studied. The diagnosis in 1 case was thymopithelioma, in another it was adenoma, and in the remaining 3 cases it was hyperplasia with subinvolution.

It is concluded that there is a true relationship between myasthenia gravis and an altered thymus.

STEPHEN A. ZIEGLER, M.D.

Management of Respiratory Complications of Poliomyelitis. Thomas C. Galloway. *Arch. Otolaryngol.* 1947 46 15.

The author stated that the problem of severe bulbar poliomyelitis is largely one of secretional obstruction of the respiratory tract with secondary anoxia. In other words, anoxia due to accumulated secretion is a most important factor in this condition.

Respiratory complications are of 3 types: (1) those due to spinal paralysis involving the diaphragm or intercostal muscles, or both; (2) those due to bulbar paralysis involving the mechanism of deglutition; and (3) those due to disturbances of the respiratory center.

Complications of the first type usually respond well to the use of the respirator. In patients with bulbar paralysis, the respirator should be used with caution; the airway should be cleared of secretion or by passes provided by tracheotomy.

The indications for tracheotomy are outlined as follows: (1) fluid in the upper airway with increasing signs of anoxia, in spite of the administration of oxygen, postural drainage, and aspiration (restlessness, dyspnea, cyanosis, disorientation and mental depression are important determinants); (2) unconsciousness or marked restlessness in a patient not previously treated and not responding to other

treatment in a few minutes; (3) marked restlessness or stupor in a patient in a respirator even if he apparently has a spinal type of poliomyelitis; (4) fluid accumulation not otherwise easily and certainly taken care of in a patient requiring the respirator; (5) rapidly progressive bulbar symptoms; (6) bilateral paralysis or spasm of the vocal cords; (7) markedly increasing signs of vasomotor failure not explained as due to a cause other than anoxia, and (8) untrained or inefficient attendants, inadequate equipment, or poor co-operation of the patient with doubt that the airway will be kept free of any secretion.

If a patient under observation loses consciousness, it probably means that intervention has been delayed too long.

ROBERT TURELL, M.D.

Pilonidal (Sacrococcygeal) Cyst and Sinus. Robert Turell. *N. York State J. M.* 1947 47 977

The author describes certain facts about pilonidal disease which became evident during World War II, and he indicates the trends of choice of surgical procedures.

It was again stated that there exists no unanimity of opinion as to the embryologic origin of this lesion. While it is agreed that pilonidal cyst or sinus is congenital in origin and that it arises from the ectoderm, it has not yet been definitely determined whether skin or neural tissue is the source of origin. Also, there is a decided lack of agreement concerning surgical therapy as attested to by the numerous new procedures and modifications of old procedures. In many instances the good results claimed by the authors of these procedures are not always obtained by surgeons other than the originators.

During World War II pilonidal disease became a major surgical problem because of its frequent occurrence in militarized personnel. It became apparent that trauma plays an important role in the activation of this lesion. The author also observed that hyperhidrosis and lack of ideal personal hygiene imposed by training and/or battle conditions are as important factors in the initiation of infection in the pilonidal cyst or sinus. Operative specimens removed at initial operations yielded hemolytic and non-hemolytic staphylococci and streptococci members of the colon bacillus group of organisms were notoriously absent in these surgical specimens. Similar findings were obtained when the subcutaneous tissue juices of the buttocks, as far as 3 cm. from the line of excision of pilonidal cysts, were studied bacteriologically.

Abscesses are operated upon as early as practicable. Through a generous incision the pus, necrotic material and, frequently, tufts of hair are evacuated and the cavity is irrigated with normal saline solution. The roof of the abscess cavity is then removed, hemostasis is secured by gentle pressure, and the

cavity is packed lightly with gauze which has previously been soaked in a solution of penicillin. In spite of excision of a large amount of overlying skin, as is frequently necessary in the case of large abscesses, the wound is usually well healed in about 3 weeks and the entire convalescence is extremely smooth. By comparison with the method of crucial incision and drainage only the wide unroofing of the abscess cavity is a far superior procedure. Recurrences in 3 to 6 months after operation have been absent.

Cysts or sinuses in civilian pre-war practice were popularly excised en bloc and packed. This operation entails a prolonged period of healing, a factor that made this operation undesirable in military war practice. To restore soldiers to duty as early as possible, various closed methods or techniques were utilized. In the author's experience, the musculofascial flap operation described by Shute, Smith, Levine, and Burch (or that of Holman) with the addition of the principle of delayed closure to the middle and upper portions of the wound, was found to be a rational and effective procedure and one that can be performed with ease after some experience with this technique has been secured. The operation is applicable to very large uninfected or previously drained cysts with or without multiple sinuses.

Recurrences may also be treated by this technique. Other forms of treatment for recurrent pilonidal disease are irradiation, injection of the sinuses with sclerosing solutions and penicillin and excision en bloc followed by immediate skin grafting, utilizing intermediate or thick split thickness skin grafts. The author's experience supports the belief that the freshly exposed area is a good base upon which to place a skin graft.

Chemotherapy, sulfonamides, or antibiotics, have a definite place as an adjunct to surgery and should be administered before and after operation, especially in the complicated cases. The author observed that penicillin given early in large doses is effective in preventing abscess formation in a certain number of cases of cellulitis of the pilonidal area which in the past, usually terminated in frank suppuration.

The choice of the form of anesthesia is of importance. Local infiltration anesthesia appears to produce a higher incidence of complications (infection) than regional or general anesthesia and thus is responsible for a longer period of hospitalization.

Injectional Treatment of Internal Hemorrhoids.

Robert Turell. *Am J M Sc* 1947 513 359.

The present article is based on a study of 100 private patients who suffered from uncomplicated small to medium-sized internal bleeding hemorrhoids with or without spontaneously reducible prolapse. Private cases were chosen for this investigation because all the details of examination, treatment, and follow up were carried out by the author in contrast to clinic patients who are not always treated and supervised by the same surgeon.

The preinjection studies included a competent general and regional digital and instrumental ex-

amination and a minimum of laboratory tests consisting of urinalysis, hemoglobin estimation and a serologic test for syphilis. A sedimentation test of the blood and a roentgenray study of the colon by means of a double contrast barium enema were made only when specially indicated.

The injectional technique is described in detail. The sclerosing agent utilized in most cases was a 5 per cent solution of quinine and urea hydrochloride 5 to 10 per cent of phenol in pure almond oil was used in a small number of patients. The first injections were made submucosally above the anorectal ring about the pedicle of each hemorrhoid. After all the hemorrhoids had thus been treated, subsequent injections were made into the hemorrhoidal masses at a lower level. Occasionally additional submucous injections were made between treated hemorrhoids in order to correct mild mucosal prolapse. Usually the injections were made biweekly. On occasions all high submucous injections were made in one sitting and subsequent interstitial injections were completed at biweekly or triweekly intervals. A total series of from 6 to 12 injections was usually required.

Postinjectional care consisted in instructing the patients to avoid straining and how to avoid constipation which may be the cause of defecatory straining. The patients were asked to feel for anal protrusions and were told how to reduce such protrusions digitally and to report such occurrences promptly.

The main clinical purpose of this treatment is to stop bleeding and to correct the associated descensus of the rectal mucosa. This was accomplished in every instance. About 65 per cent of the patients remained symptom free during a follow up period of observation ranging from 30 months to 3 years. Reinjection was required in over 30 per cent of the patients because of recurrence of hemorrhoids causing bleeding 9 months or more following the conclusion of the original course of treatment.

Seven cases of inconsequential superficial slough at the site of injection were observed in this series of patients.

Surgical excision in a large number of cases was compared and contrasted with injectional treatment. As a result of this study operation is usually not applied to the treatment of small or medium-sized internal hemorrhoids, but is reserved for the treatment of large internal or interno-external (mixed) hemorrhoids and hemorrhoids that are associated with or complicated by anorectal lesions that require surgical excision.

ROBERT TURELL, M.D.

The Operative Treatment of Decubitus Ulcer. Edmund J. Croce and Charles H. C. Beaken. *England J M* 1947 537 141.

The management of decubitus ulcers in 130 paraplegic patients at Halloran General Hospital, Willowbrook, Staten Island, New York, over a 15 month period is reported. Operative treatment is indicated because it boosts morale, terminates loss of tissue

protein and increases appetite, strength, weight and general well being. The objects of treatment are to obtain early complete closure and to obtain a permanently stable closure. Split thickness grafts are frequently used as an early expedient in patients not ready for more extensive surgery but should be replaced by full thickness grafts at a later date in order to obtain a stable closure. In the early phase the decubitus ulcer exhibits extending necrosis, and the exudation of body fluids is profuse. Treatment at this stage must consist of restoration of protein anabolism, conservative débridement of necrotic tissue, chemotherapy and transfusions. Later when necrosis ceases, healthy granulations appear and cellulitis subsides, the wound should be temporarily closed by split thickness grafts.

Though bacteriological studies were carried out in preparing for coverage with extensive flaps, more reliance was placed on the appearance of the wound than on the culture. An ulcer was considered ready for this procedure when cellulitis subsided, healthy granulations presented, nonviable tissue had separated, exudation had practically ceased and the wound margins presented proliferating epithelium. Most patients required no anesthesia since most ulcers were below the sensory level. Operative technique required sharp dissection, excision of all scarred tissue, fine silk hemostats, flaps sufficiently extensive to allow closure without tension, thorough irrigation of the wound with saline, dusting with plasma penicillin powder and the maintenance of pressure dressings.

The sacral ulcers were closed by sliding flaps upward from the buttocks and medially from the lumbar regions, depending on the size and shape of the defect. Trochanteric ulcers presented a more difficult problem due to the tightness of the skin over the hip, the mobility of the area, and the frequent occurrence of false burrs. These were usually closed by linear suture, single sliding flaps, or double sliding flaps. It is believed that immobilization in a padded spica with the hip abducted will improve results.

Paraplegic patients frequently developed redness and swelling over the ischial regions and if these areas were mistaken for abscesses and incised, ulcers then developed which communicated with a chronically infected ischial bursa. These are best treated by excision and linear closure. Calcaneal ulcers were treated by nonoperative methods.

ROBERT ALATO TENERY, M.D.

Anomalies of the Extremities and Their Genetic Problem (Le anomalie della estremità ed il loro problema genetico) G. LUG. *Riv Ital Sci.*, 946, 29-93.

The 3 cases of anomaly of the extremities reported by the author represent 3 different processes, one of addition and one of subtraction. One is a case of polydactylism and the other a case of perodactylism made more complex by the absence of 3 metacarpal bones and abnormal structure of the only finger present which made it impossible to identify it as a finger.

In the discussion of the etiology the author states that external causes, e.g., diseases of the uterus and adnexa, hydramnios, small uterus, are not factors, but in polydactylism internal causes are very important. The problem of teratogenesis is not explained by Rabe's article on polydactylia, schizodactylia, diplocheiria and dipodactylia, neither is the problem elucidated by the atavistic theory of Foltz, Bardeleben, Albrecht, and Darest.

The author adheres to the teachings of Spemann (1918) namely that embryonal development depends on successive organizing actions. These actions are of the first and second order and include those which have to do with the development of single organs. Any abnormal development due to internal causes must follow abnormal behavior of the organizers themselves. These organizing factors go beyond the cellular limits and may transmit themselves by contact. Studies undertaken to ascertain the nature of these organizing factors have focused the attention of everyone on the sterols.

According to Witsche, all teratological events are due to an alteration in the metabolism of the sterols. If this hierarchy of inductive actions is admitted, then the development of an extremity becomes a secondary process, and in our first case—the case of addition—we have a morphological hyperproduction of the normal parts of the extremity while in the second—the case of subtraction—a more or less altered structure follows an evolution influenced by regional characteristics. It is hard to determine the "primum movens" of this teratological deviation. It is important to add that these sterols, which constitute the organizing substances, are influenced by male and female hormones. JOSEPH M. A. PATE, M.D.

DUCTLESS GLANDS

Augmentation of Thyrotropic Potency by Goitrogens. Alexander Albert, Rufon W. Rawson, Priscilla Merrill, Beatrice Lennon, and Charlotte B. Riddell. *Endocrinology* 1947 40 303.

The authors observed in control experiments that the exposure of known amounts of active thyrotropic (TSH) extract to a variety of reducing agents resulted in enhancement of the thyroid stimulating activity of the extract, the augmenting effect by goitrogenic agents being proportionately much greater than that induced by nongoitrogenic compounds. Furthermore, they found that the augmenting action was not dependent on the continued presence of the augmenting agent during the bio-assay procedure.

As is well known, thyroid weight and mean acinar cell height are directly and thyroidal iodine concentration inversely, proportional to thyrotropic activity within certain limits of dosage. By virtue of its greater sensitivity and measurability, calculations were made entirely from the values of thyroidal weights.

That reduction per se did not completely explain the results obtained was evident from the observa-

tion that ascorbic acid a strong reducing agent destroyed TSH activity instead of enhancing it.

DAVID H. LYNN M.D.

The Effect of Goitrogenic and Other Reducing Agents on Inactivated Thyrotropic Hormone Extract. Alexander Albert Rulon W. Rawson Patricia Merrill, Beatrice Lennon, and Charlotte B. Riddell *Endocrinology* 1947 40 199.

It has been shown previously that treatment of a thyroid stimulating hormone (TSH) extract with elementary iodine resulted in precipitation of most of the proteins of the extract the precipitate having lost from 95 to 100 per cent of its original thyrotropic activity. Removal of 60 per cent of the iodine from this precipitate by trituration in an excess of acetone restored the original thyrotropic potency to the protein residue. Several goitrogenic reducing compounds were similarly found capable of reducing the loosely bound iodine and reactivating to varying degrees of original thyrotropic activity the hormonal iodinated TSH extract precipitate. Identical effects were accomplished with nongoitrogenic reducing agents although when sodium hydroxide was used, hormonal activity was not restored.

The results of this study concerning the effects of reducing agents, including control experiments showed that the reactivation of the iodinated TSH extract was due to some interaction between the reducing agents and the iodinated precipitate and not to the reducing agents themselves or to their interaction with any one of the other two compounds (TSH and iodine) of the system.

DAVID H. LYNN M.D.

The Thyroxine-like Action of Elemental Iodine in the Rat and Chick Samuel Droskin *Endocrinology* 1947 40 334

Experiments designed to determine whether iodine has an action similar to that of thyroxine were based on four known actions of thyroid gland powder and thyroxine (1) the ability to restore and maintain growth after thyroidectomy (2) the ability to restore the weight of the adrenal gland of thyroidectomized rats to normal, (3) the ability in normal rats, to cause involution of the thyroid gland epithelium and to decrease the weight of the gland (4) the ability to prevent hypertrophy of the epithelium of the thyroid gland and to prevent increase in weight of the gland due to the administration of thiouracil or sulfadiazine to normal rats. The iodine was tried in two forms as elemental iodine (I₂) and as reduced iodine (I⁻) in the form of the iodide (NaI). The effectiveness of oral and parenteral modes of administration was also determined.

The results of the experiments were as follows (1) when a solution containing elemental iodine was injected subcutaneously in young female thyroidectomized rats bone growth was reinitiated and body length increased. An equivalent dosage of iodide gave only minimal growth stimulating effects (2) elemental iodine administered subcutaneously

prevented the loss of weight of the adrenal gland which occurred in thyroidectomized animals iodide did not prevent it (3) the elemental iodine given subcutaneously to normal young female rats caused a marked decrease in the height of the cells of the thyroid epithelium and an accompanying decrease of weight of the gland equivalent injections of iodide did not alter the weight of the gland and lowered the cell height only slightly (4) the goitrogenic effect in thiouracil in chicks and rats and of sulfadiazine in rats was greatly or completely inhibited by the subcutaneous administration of a solution containing elemental iodine. Iodide in equivalent subcutaneous dosage did not alter the histological character of the gland but did reduce its weight somewhat. When the elemental iodine solution was given orally it had no more effect on thyroid weight and structure than did the iodide given orally.

The experiments demonstrated clearly that elemental iodine administered subcutaneously to rats and chicks produced effects similar to those of thyroxine whereas iodide administration produced only minimal thyroxine-like activity. The results emphasize a fact to which other investigators have called attention, namely that oxidative mechanisms are important in the formation of thyroxine in the body. Such mechanisms apparently liberate elemental iodine which can then be incorporated into the molecule of an organic compound. Although the existence of an iodase in the thyroid gland having ability to oxidize iodide to elemental iodine has been postulated no such enzyme has been definitely isolated. BENJAMIN F. LOUNSBURY M.D.

Contribution to the Diagnosis and Treatment of Virilism. Hans Ludwig Kottmeier *Acta obst. gynec. scand* 1947 27 131

Virilism in the menopause is usually physiologic although its pathogenesis is still obscure. Virilism in fertile women is frequently a pathological symptom but one must distinguish between virilism and hirsutism because the latter may be hereditary. In masculinizing ovarian tumors the following symptoms may coexist: amenorrhea, atrophy of the breasts, masculine mental and physical characteristics, low pitched voice, excessive hair on the face, thinning of the hair of the scalp, pigmentation and pustulation of the skin and hypertrophy of the clitoris. These same symptoms may also accompany tumors of the adrenal cortex. Cushing's syndrome may present these same symptoms plus a painful type of obesity, dry skin, striae, moon face, demineralization of the skeleton, hypertension, hyperglycemia, glycosuria and erythema. This syndrome has been attributed to "pituitary basophilism" but the pathological etiology is becoming increasingly obscure.

The author believes that the term arrhenoblastoma should be reserved for those ovarian tumors which are accompanied by masculinization and he agrees with R. Meyer that masculinization symptoms are more pronounced in the least differentiated tumors.

INTERNATIONAL ABSTRACTS OF SURGERY

The author prefers the term arrhenoma rather than arrhenoblastoma because it does not refer to the genesis of the neoplasm, which is still obscure.

Three cases of arrhenoma are presented from the Radiumhemmet, Stockholm Sweden. Two of these were improved after oophorectomy the third case terminated fatally because of bone metastases from a local recurrence of the tumor. In view of this case the author believes radiotherapy should be considered after surgery even though there is no pathological evidence of malignancy.

Two cases of Cushing's syndrome from the same clinic are presented. In both cases the signs and symptoms were pronounced and radiotherapy of the hypophysis was given without exploration of the adrenals since this procedure is considered dangerous in patients with Cushing's syndrome. Both patients showed marked improvement after irradiation and the author believes that this is further evidence that the hypophysis is involved in this condition.

ROBERT MAYO TERRY, M.D.

EXPERIMENTAL SURGERY

Curare and Shock: The Production of Hemorrhage Into the Upper Intestine of the Dog with Large Doses of Curare. Frank Cole Ivan D Baronovsky and Owen H. Wangersteen. *Surgery* 947: 182.

The objects of this experimental study on 18 dogs were the determination of the mechanism of the production of intestinal congestion and bleeding, the pathologic changes developed by large doses of curare, and the effects of large amounts of curare on the blood pressure.

Intocostin, a preparation of curare, was used in doses ranging from 0.035 to 1.335 c.c. of Intocostin per pound of body weight and were always given as 1 injection and rapidly.

The results suggest the necessity for close scrutiny of the doses used in man. It has been shown that the minimal lethal dose of Intocostin in the dog is 0.065 c.c. per pound of body weight. If artificial respiration is used pathologic changes appear with doses of 0.650 c.c. per pound. Dogs can be killed by doses of 1.3 c.c. per pound even when artificial respiration is maintained. In man 0.035 c.c. of Intocostin per pound is commonly injected, and as much as 0.20 c.c. Doses sufficient to produce muscular relaxation and respiratory depression appear to be nearly alike in proportion to body weight in man and in the dog. The dog appears able to withstand anoxia better than man.

It was found that when large doses of curare (from 0.718 to 1.240 c.c.) were administered intravenously in single injections to dogs kept alive by artificial respiration for from 2 to 5 hours, congestion and a fatal fall in the arterial blood pressure were produced in shock. Intestinal bleeding does not occur when the systolic blood pressure is maintained at a level between 80 and 90 mm. Hg.

It has been known that intestinal hyperemia, mucosal hemorrhages, and duodenal and jejunal ulcerations were found in late shock along with congestion of the liver, spleen and kidneys. The authors conclude that the intestinal pathology found on the basis of the shock produced.

These experiments show that curare does not stimulate gastric secretion nor does it produce gross congestion of the mucosa of the small intestine when applied topically. Vasoconstricting drugs such as epinephrine and ephedrine will prevent the severe depression of the arterial blood pressure subsequent to the intravenous injection of large amounts of curare. The failure of transfusions of whole blood to maintain the blood pressure is attributed to the inhibition of the vasomotor center and ganglia caused by curare. The potential "lake" formed by the dilation of the visceral vessels and these organs cannot be filled fast enough, and little, if any, blood returns to the heart. The heart itself is affected by large doses of curare and this occurrence in itself will prevent a blood pressure rise after transfusion.

When shock is averted, intestinal hemorrhage is not seen. Shock is therefore, the most likely cause of the intestinal hemorrhage resulting from the intravenous injection of large amounts of curare.

JOHN H. MONARD, M.D.

Studies of Thermal Injury: An Exploration of the Causality Producing Attributes of Conflagrations; Local and Systemic Effects of General Cutaneous Exposure to Excessive Chromatophore (A1r) and Circumradiant Heat of Varying Duration and Intensity. A. R. Moeht, F. C. Henriques, Jr., F. R. Dutra, and J. R. Weisberg. *Arch. Path., Chic.* 947 43 466.

In a series of pilot experiments, in which guinea pigs were burned in a fireproof chamber with and without adequate ventilation the changes that occurred in the oxygen carbon dioxide and carbon monoxide contents were observed, the temperature of the air was measured and the results of exposing animals to such conflagrations were observed. The most important information gained from these pilot experiments was that large animals, exposed to such conflagrations may receive injuries that are almost immediately fatal, and that the fatality is not necessarily contributed to by asphyxia, carbon monoxide poisoning, or inhalation of flames or fumes. Almost immediate death may result from systemic disturbances caused by the heat flowing through the surface of the body.

Source temperatures of about 90 degrees centigrade could be tolerated for 45 minutes without burning, whereas, at 100 degrees burning occurred in 15 minutes, and at 120 degrees, 30 seconds was the longest exposure that could be tolerated without irreversible cutaneous injury.

Although the temperature of the skin was considerably lower than that of the heat source in the

hot air exposures, the relationships of time and tissue temperature that were responsible for cutaneous burning in these experiments were essentially the same as those that prevailed in the experiments with hot water exposures. At relatively low temperatures of heated air (under 120 degrees C) man is less susceptible to injury than the pig because of his ability to sweat. It is doubtful, however that sweating provides a significant degree of protection at temperatures over 120 degrees centigrade because, at such levels, the rate at which heat is transferred to the skin is much more rapid than the rate at which it can be dissipated by vaporization of sweat. The relationships of source temperature to production of injury established by the experiments, apply only to unprotected skin and are not valid for exposures in which hair or clothing is interposed between the skin and the source of heat.

Excessive circumambient and circumradiant heat, though applied for periods as brief as 30 seconds is capable of precipitating in pigs, dogs, and goats physiologic disturbances of sufficient severity to cause death within a few minutes. The severity of the physiologic disturbances that result when animals are exposed to excessive heat is often disproportionate to that of the cutaneous burning. Rapidly fatal systemic hyperthermia may result from long duration exposures at temperatures insufficient to cause cutaneous burning. Higher intensity exposures may cause extensive and severe cutaneous burning and yet be of too short duration to cause a significant rise in body temperature.

The severity of the immediate physiologic disturbances resulting from exposure to excessive heat appears to bear a direct relationship to the extent to which the body temperature is increased. Exposures that failed to cause the rectal temperature to rise above 42 degrees centigrade rarely resulted in rapidly fatal circulatory failure those that caused it to rise as high as 44 degrees invariably did. In the pig such a rise in body temperature may occur within a few minutes after cutaneous exposure to excessive heat and does not persist for more than a few hours after termination of the exposure. In animals that died within a few minutes after being exposed to excessively high environmental temperatures the temperature of the heart's blood was consistently higher than that recorded by a rectal thermometer the shorter the interval between the onset of the exposure and the death the greater was the difference between the two temperatures.

Apart from the cutaneous lesions the pathologic changes observed at autopsy are not pathognomonic of thermal injury. Subendocardial ecchymoses were the most constant abnormalities found in animals that died during or soon after exposure. Other post mortem findings included stasis of blood in the peripheral vascular bed moderate dilatation of the right auricle, and persistent fluidity of the blood. In the case of extensively burned animals there was intra vascular hemolysis. Blood smears showed fragmentation of erythrocytes. In animals that survived

severe thermal exposures as long as 24 hours the urine was found to contain large amounts of hemoglobin, and degenerative changes were frequently identified in the cells of the renal tubules the adrenal cortex, and the liver
SAMUEL KAHN M.D.

The Predictability and the Significance of Thermally Induced Rate Processes Leading to Irreversible Epidermal Injury F C Henriques, Jr
Arch. Path. Chlc. 1947 43 489.

Of all the physical and chemical processes known to date, thermally induced epidermal injury is probably due primarily to thermal changes of those proteins and enzymes whose rate of alteration corresponds to an activation energy of at least 150 kilocalories per mol and an entropy change of about 395 units. This is consistent with the known existence of a reversible phase of latent epidermal injury
SAMUEL KAHN M.D.

The Effect of Powdered Whole Blood Cells and Plasma on the Healing of Wounds (Sull'azione delle polveri di sangue, di globuli rossi e di plasma nei processi di guarigione delle ferite) U Brancato
Rass. internaz. clin. ter. 1947 27 87

Uniform wounds were studied in several dogs, and the effect of desiccated preparations of whole blood cells and plasma, locally applied, was estimated by tracings on sterile glass slides. Wide variations in the rate of healing were found in the controls as well as in the treated wounds. No advantage was observed as a result of using materials prepared in the author's laboratory. Powdered red cells furnished by the Istituto Sieroterapico di Milan on the other hand appeared to hasten healing.

EDITH B FARNSWORTH M.D.

Fascia Lata Regeneration Animal Experimentation J C. Poolee
Surgery 1947 21 800.

This study was undertaken to obtain pertinent data relative to fascia lata regeneration. With sterile technique throughout and fine silk for hemostasis as well as for the purpose of identification during succeeding operations 22 experiments were performed on the fascia lata of 3 dogs at 3 different periods. When both extremities were opened during the same operation it was considered 2 separate experiments. In most of the procedures a small segment of fascia lata was excised and the superficial wound was closed with silk. In some 2 defects were fashioned to leave an intervening strip of normal fascia lata. In 3 additional experiments, the segments were rostited 90 degrees after being cut, one being turned over as well to interchange the inner and outer surfaces. Subsequently the sites were reopened after from 14 to 97 days and grossly inspected, and a block of tissue consisting of the regenerating area as well as a rim of adjacent normal fascia was removed for microscopic study.

Normally fascia lata possesses an inner and outer transverse and a middle longitudinal layer. Once a defect was produced the regeneration was charac

teristic in all save 1 instance. The middle layer atrophied and disappeared while the inner and outer layers regenerated by extension directly from their respective layers in the adjacent normal fascia lata together with their sheaths and blood vessels. Furthermore the transverse layers underwent hypertrophy and hyperplasia if they were required to take over the full compensatory pull of the middle layer when the severed segment of fascia lata was rotated 90 degrees. This confirms the early studies of Kleinachmidt.

The author concluded from these experiments that in a medium sized defect the average rate of regeneration is as follows:

At the end of 2 weeks the regenerated fascia lata is only a thin veil. It becomes more dense rapidly. At 3 weeks it is a well defined membrane. At 1 month it is half as thick as normal fascia lata, and at 2 months it is grossly and microscopically as thick as the normal fascia. In a very large defect the process of regeneration may be slower but in a smaller defect it may be so rapid that in 1 month the regenerated tissue will become as thick as the normal fascia lata.

D. VAN H. LYNN, M.D.

Fascia Lata Regeneration. Final Report. J. C. Forbue. *Surgery* 947 89

A clinical study of the regeneration of fascia lata in 5 patients from whom fascia lata had been removed for the reoperative repair of hernias is presented. This publication is a supplementary report to a previous article on fascia lata regeneration by the author.

Microscopic study of fasciae from patients who had been reoperated upon revealed that the healed fascial tissue was not scar tissue but a structure of well organized layers of certain parts of the normal fascia lata, such layers having their own sheaths, and

these sheaths were combined in a common sheath, each sheath having its own minute blood vessels.

Normal fascia lata is comprised of 3 layers, namely an inner transverse layer, an outer transverse layer, and a strong middle longitudinal layer. Each layer is enclosed in its own fine sheath and all 3 layers are encased in a denser common sheath. Evidence is presented that it was the inner and outer transverse layers that were regenerated. These layers were in continuity with and extended directly from their corresponding layers in the normal fascia lata which extended across the defect regardless of its size.

The conclusions deduced are that it is not necessary to suture layers of fascia across the defect from which a transplant has been taken, or to make an effort to repair the defect to prevent herniation, a herniation will be prevented by the newly formed fascia. The more active the individual, the more dense and better developed will be the regenerated fascia, and the regenerated fascia from 6 months to 1 year of age will be of sufficient density and tensile strength to be used successfully in surgical procedures in which ordinarily normal fascia is desired but lacking.

This study does not appear to substantiate the work of Gratz, to the effect that fascia will develop anywhere in the body from muscle where fascia is needed. In every instance in this work it was shown that the regenerated fascial layers are direct extensions across the defect of the corresponding layers of adjacent normal fascia lata. The thickness and density of the inner layer of the regenerated fascia in comparison to these qualities of the outer layer suggests the importance of the proximity of muscle to the success of fascial regeneration. This has been disclosed by the loose attachment to the muscle by trabeculations as in normal fascia lata.

JOHN H. MCMANUS, M.D.

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THE USE OF ISOTOPES IN SURGICAL RESEARCH

FRANCIS D. MOORE, M.D., F.A.C.S., Boston, Massachusetts

THE rapidly widening horizon of medical research with radioactive and stable isotopes of the common biologically important elements has long since come to include the sphere of surgery. Indeed surgeons were among the earliest of the clinical groups to employ these useful tools in the study of physiologic and biologic problems.

Such materials are now becoming widely available for surgical research in this country and in foreign countries. It is especially appropriate to review in brief some of the salient points of the history of this type of work, its biologic potentialities and a few of the practical problems facing the investigator. It is with this purpose in mind that the material presented herewith has been gathered together.

It is important to acknowledge at the outset that the author is not a physicist; he has had little contact with the recent physical marvels from betatron to Bikini. The thoughts expressed herein are based on a limited experience over a 7 year period with radioactive isotopes of bromine, chlorine, iodine, sodium, potassium, iron, phosphorus and with deuterium. Although we must deny that research with isotopes is a field in itself any more than research with a colorimeter constitutes a field in itself, there are certain pertinent considerations which may help the investigator. It is our present purpose to outline some of

these—though they may seem elementary to some and controversial to others. The fundamental physics of the materials and devices herein discussed are set forth in several standard works and no effort to review this material will be made in this paper (12, 21, 31, 36, 40, 43, 44, 56, 68).

The period of cyclotron production of radioactive isotopes for biologic research (1939-1945) saw the initial exploration of this area by a small number of investigators. On the physical side, techniques of production, separation, and measurement of radioactive isotopes of most of the biologically important elements were developed. Biologically, the *in vivo* distribution of these substances was studied, permeability and rates of exchange were observed where possible, and in certain instances the incorporation of active atoms into the complex organic materials was investigated.

Many lessons about investigative technique were learned. Though the use of radioactive materials involves many physical problems and though the physicists were responsible for the discovery, production, and separation of the isotopes and their measurement, the medical application of these materials was soon found to be a biological or biochemical problem at heart—with physics only as hand maiden.

If one is to study bone physiology with Ca^{45} , it is important to know what in general is meant by a beta ray energy of 0.25 Mev, as this concerns the counter window thickness

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or the preparation of samples with a constant coefficient of self absorption it is wise to be aware of the relation of half life to working usefulness of the isotope mixture. If these considerations be physics then they must be accepted as such and learned. But the mate kinetics of the nuclear reaction involved the gain or loss of a neutron the factors involved in capture cross-section and similar matters are physical and technical problems whose details need not concern the medical investigator. In the sense of time spent, the less he knows about them the better. To use a photoelectric colorimeter one need not study the physical basis of light transmission, absorption and optical systems, as long as the essential limiting factors are understood and given their due respect.

This was the first lesson learned in the cyclotron period though the application of isotopes to medical and biological research is in effect a collaboration between biochemist and physicist it is the biologist who must point the way and name the destination.

The second lesson learned from the cyclotron was a corollary to the first and might be stated thus. Isotopes do not solve problems. Isotopes plus intelligent biological conduct of the experiment and its ancillary concepts, techniques and analyses are capable of giving more answers than the concepts, techniques and analyses alone. The radioactive material and the Geiger-counter result do not provide solutions by themselves—it is their *biological context* which gives them meaning and significance. If this context is well planned and executed, the result is often of great importance if not, the radioactivity might as well have been allowed to decay quietly behind its lead shielding.

Now temporarily at least the cyclotron is somewhat less important in the medical picture. That colorful and temperamental device is undergoing expansion and perfection at the hands of its progenitors, the physicists. Its unpredictable vicissitudes have been replaced by forms in quadruplicate and on-the-clock delivery of materials formerly obtained only with difficulty. The cyclotron has given way to the chain-reacting pile (1 48

This new source of radioactive material in biological research has opened the way for investigators not situated in the established physical biological centers the pile makes these materials available to many rather than only a few of the country's surgical laboratories. Among the many newcomers to this field will be those who make the significant discoveries of the next decade their ability to produce worth-while information will be a function of preliminary understanding of the biologic problems they seek to solve. The more who set out, the greater likelihood of a few reaching the goal—and therein lies the true importance of the pile. It mass-produces a precious scarcity item.

I TYPES OF PROBLEMS

Although the types of biological research which may be carried out with radioactive isotopes are many they tend to arrange themselves into several significant subheadings.

1 *Permeability and membrane transfer.* In the study of the penetration of ions or molecules from one area of the body fluids to another isotopes make their greatest fundamental contribution to research. It is impossible to study certain types of membrane-permeability problems without tagged substances of some sort. Though one may place the red cell in plasma and carry out studies of the chemical constituents of the red cell and of the surrounding plasma, it is difficult to assess the permeability of the normal, healthy, red-cell membrane to its contained ions without the use of isotopes (6 50). The essential function of the isotope in this type of study is to allow the investigator to place all the material he is tracing in one or the other compartment and still maintain the system in chemical equilibrium. As one contemplates a red cell in its plasma it is apparent that there is potassium on both sides of the membrane. If the investigator alters the cell or its medium in such a way that the total chemical composition within the red cell changes by increasing its potassium content, it is of course clear that this potassium has come into the red cell from the surrounding plasma because there is no other source for it. But under stable equilibrium conditions such as those which obtain

in the body in the absence of disease one has no way of knowing whether or not any of the potassium within the red cell can exchange with the potassium in the surrounding medium unless there can be placed in the plasma a form of potassium which is identifiable once it gets into the red cell, as having come from the plasma. In such cell permeability problems, tagged substances provide the only means of obtaining a satisfactory answer. Whether that membrane be the capillary the lymphatic, the cell, the nucleus or some special barrier such as the glomerulus or choroid plexus, and whether the tracer be an ion or a large protein molecule, isotopic techniques inform the investigator of the relationships between the two sides of the membrane in a fashion which cannot be gained in any other way.

2 *Tracing metabolic pathways* Though we can dissect a whole animal and analyze its constituent organs chemically for an element we have no way of knowing the previous position of the element as found in the various organs nor its distance in point of time or metabolic pathway from its source such as the gastrointestinal tract. By the use of a tagged element it is possible to give one radioactive dose to the organism and at varying periods after administration to analyze the animal and find the position in the various organs and body fluids of this single dose. When one has analyzed the whole organism some hours after a feeding containing a radioactive element the distribution which one finds is presumably typical for the distribution of any similar amount of stable element administered the organism. The total dose given must be carefully considered in this type of work. The smaller the total gravimetric quantity of the element used (the more closely it approximates a true "tracer" dose) the more one may assume that its metabolism has been typical of the organism's handling of a single dose of that substance. If the radioactive material is given in a large dietary amount of isotopic mixture, then, of course, other problems such as toxicology and kidney function may be brought into play. By such studies of individual ions or elements much has been learned of the dietary metabolism of such substances as cal-

cium iron iodine and the physiologically important electrolytes. Now, with radioactive molecules of greater complexity becoming available more of this type of metabolic pathway mapping may be carried out relative to the metabolism of complex organic materials.

3 *Utilization by specific organs* As a refinement of the above investigation it is possible by means of isotopes to study the utilization of elements or compounds by specific organs. An outstanding example of this historically is the utilization by the thyroid of iodine (32-33). The physical and biological characteristics of iodine were in a sense a fortunate coincidence to the early workers in biology using radioactive isotopes. Certain radioactive isotopes of iodine are readily produced their physical emanations adapt themselves well to ordinary measurement techniques and the spectacular localization of nearly all of this element in one organ provided materials for tissue study which has yielded a mass of important information. Alteration of biological conditions either in the organism as a whole or in the tissue itself studies in tissue culture, studies in health and disease as well as methods of therapy have grown from this work. Had the radioactive isotopes of calcium sulfur, nitrogen, carbon oxygen and hydrogen been as readily applied to biological experiment as iodine has been what a mass of work already would have been accomplished on other important metabolic problems!

The autoradiograph presents the most intimate picture of utilization of elements or compounds by specific tissues and belongs in this category of observation. The autoradiograph is a record made on photographic emulsion by the beta radiation of isotopes previously administered to the animal or patient by comparison with microscopic slides and suitable magnification exact histochemical localization of isotopes may be obtained (3-45-46).

4 *External localization* The concept of injecting a radioactive substance into an animal or a patient and then casting about over the living organism with a Geiger counter to find out where the element went has gripped the imagination of investigators and public for many years. In the case of the thyroid the selective localization of the radio-iodine in

thyroid tissue wherever that tissue is, has provided again, by coincidence a ready application of such methods (33). Studies of the circulation by externally placed counters, using Na^{22} have also been carried out (63). Here however the lack of selective localization makes interpretation much more difficult. Attempts to collimate the beam of radiation by suitable screening of the counter occasionally help but such efforts nearly always interpose a greater distance between the radioactive source and the counting instrument in such a fashion that, by the law of inverse squares intensity is sacrificed for point localization. Experience with radioactive dyes and their localization in abscesses demonstrated that at least in the case of radiobromine external localization could best be produced by a minimum of shielding and also a minimum of distance between the radioactive source and the counting instrument (52, 65). The inverse square law is the investigator's best friend in this type of work. The intensity of counting rates using external counters on the intact organism is found to have a characteristic pattern for almost any element or compound used. Departures from this pattern are the significant finding and these departures are readily demonstrated if the normal distribution is well understood as a preliminary. Variations in thickness of the subcutaneous tissues and skin produce such differences in counting rates that quantitative relationships between dose and external measurement are difficult to establish except on an empirical basis.

5. **Tagging of complex compounds.** The study of complex compounds appears to represent a principal future effort in isotope research. Attempts to label complex organic materials with radioactive isotopes go back to the earliest days of the cyclotron. Many physiologically important molecules which contain such elements as carbon, phosphorus, iodine, iron or sulfur and which were susceptible of synthesis could be synthesized with the radioactive element in place of its stable isotope (13, 47). It should be mentioned in this connection that although gamma rays penetrate tissues to a depth of several centimeters their ionizing effect is localized in their immediate path and, hence, the lower ionization produced per unit of path and, hence, the lower counting efficiency in the measurement of gamma radiation.

61, 62) It is apparent from casual consideration of this problem that for the tracing technique to be valid the element involved must be in stable linkage in the organic compound. If one uses sodium or lithium salts of a compound with the radioactivity on the cation dissociation in solution separates the activity from the compound in question and subsequent counting rates are nonsignificant (72). Further such rapid metabolic breakdown that the tagging element is rapidly divorced from its chemical partner and subsequent physical analyses yield little information other than that concerning breakdown. In addition is the element made radioactive compounds were tagged by the extrinsic linkage of radioactive substances such as bromine or iodine (23, 66). These compounds provided much interesting information but occasionally suffered from the fact that the radioactive halogen or other element attached to the organic molecule so changed its behavior that physiologic measurements were misleading as regards the behavior of the normal substances in the organism.

The work of Schoenheimer and his co-workers with heavy nitrogen and deuterium has pointed the way for the future of this field (59). Their work and the work of Conant and Hastings with carbon (7) demonstrated the fundamental importance of using tracers from the biologically most important elements. By such techniques, paying careful attention to the precise chemical position of the tagging substance and the stability of the tagging linkage the physiologic behavior of most of the important compounds of the body may be studied. Compounds which cannot be synthesized in the laboratory may be made radioactive by using natural syntheses carried out by the living organism. Such methods have already yielded much information on hemoglobin metabolism (using radioliron) (50) and on protein metabolism (using sulfur) (61, 62). There are other examples where living organisms or bacteria have been used as a synthetic partner in such researches. The present availability of C^{14} has an almost front rank

importance in isotope research because of its use in the study of the more complex organic compounds

6 Fluid space measurement The measurement of volumes of body fluid available for the solution of an ion may be carried out by dissolving a tracer for that ion in the body fluid space in question allowing mixing to occur making appropriate corrections for excretion and then studying the final dilution obtained. The tracers used for this type of work have classically not been radioactive. The use of bromine as a tracer for chlorine allowed Hastings to make many of his fundamental observations on the extracellular space (67). The use of the blue dye as a tracer for plasma protein has enabled investigators to make measurements of the plasma volume (15, 24, 28, 41). Other techniques involving the use of isotopic tracers have developed measurements of the extracellular space (using radiosodium or radiochromine) (39) and total body water (using deuterium) (50). By the use of the same fundamental calculation the total quantity of other elements in the body may be determined. These methods will be dealt with in greater detail below.

7 Therapy with radioactive isotopes This is an application of radioactive isotopes dependent upon selective localization in pathologic tissues. In a sense this occupies a separate position from the strictly investigative use of the isotopes and as such will not be dealt with further in this article.

II. ARRANGEMENT OF PROJECTS

It is wise, in setting up a research project employing radioactive isotopes to follow certain general principles. The first of these has to do with physical collaboration.

1 Collaboration of physicists At the present time when pile produced isotopes are used the collaboration of a department of physics for the production of isotopes is no longer as essential as it formerly was. The co-operation of persons trained in radiochemistry is of vital importance if the investigator does not have at hand either the chemical or physical techniques required in the separation or preparation of isotopes for biological utilization. The most important aspect of this at

the present time has to do with safety precautions. Special equipment is required in the handling, purification, separation and dilution of isotopes which are received from the Atomic Energy Commission especially if these are shipped in the dry state. Commercial enterprises making such services available are coming into being at the present time and will remove a very real burden from the physicists.

For detection and measurement of isotopes in the tissues or body fluids which represent the end points of the investigation the help of the physicist is often required in the setting up or designing of apparatus. It is a mistake however to set up a research project with a detached physicist performing the sample measurements in a laboratory far removed from the biological aspects of the experiment. Under these circumstances the accurate correlation of physical and biological measurements which is so necessary to success is difficult. Furthermore this type of project in which the physicist is used simply as a technician to make or supervise the end point readings places the physicist and his laboratory in an unsatisfactory position and constitutes research by committee, a notoriously inefficient way of operating. If the isotopes used emit beta rays with energies sufficient to be measured on ordinary counting apparatus it is advisable for any research project to be organized in such a fashion that end point measurements may be made in the laboratory in which the biological experiments are carried out. The services and support of a well qualified physicist to help solve problems which come up relative to radioactive contaminants, double isotope experiments or measurements of unusual or difficult substances such as gases or weak radiation, should be available. Such a research project will be most successful if the physicist plays the rôle of consultant and is not relied upon too heavily for isotope preparation, sample measurements or biologic interpretation.

2 Cost of equipment The cost of research with isotopes is still greater than that of many other types of biological investigation. The necessary physical equipment at the present time costs approximately five hundred to one

In our opinion, the most vulnerable point in the technique of handling radioactive isotopes in medical investigation is the fingertip. There is little evidence that the amounts of radiation involved even with the use of isotopes emitting energetic beta and gamma rays will do damage to bone marrow or gonadal function *when only tracer amounts are involved*. However, fingertip contamination or even fingertip exposure might lead to serious subsequent injury. One should bear in mind that if the fingertip is 2 centimeters away from the flask and the sternum is 80 centimeters away the fingertip is receiving 1,600 times as much radiation as the sternum per unit of flat surface. Furthermore, the fingertip unlike the sternum or the region of the gonads, may be contaminated by liquid containing fairly high activities—as is found in a freshly diluted specimen of pile produced activity prior to injection into the animal or patient. Such fingertip contamination is notoriously difficult or impossible to remove. Anyone who has had experience in this area knows the consternation encountered when after scrubbing one's hands for 10 minutes they are placed under a Geiger counter and an intense discharge of counts is produced. This dramatically demonstrates the fact that in working with radioactive materials one is dealing with atoms and that they cannot all be removed even with a scrubbrush.

Protection of fingertips can be aided by the use of rubber gloves when high activities are handled. The rubber has no shielding value but it prevents actual liquid contamination of finger creases and fingernails. The use on the fingers of rings containing photographic film is still in an experimental stage and may add a useful precaution. However in the last analysis we come back to our old friends education, time, and distance.

If our present knowledge of exposure hazards and safety factors were complete it would be possible to list the late effects in human beings of the subclinical radiation dosages encountered in biologic research. That knowledge is not complete and excessive possibly unnecessary precautions are justified. One need only recall the damage and suffering which resulted from early and seemingly cau-

tious use of the roentgen ray to understand the necessity for excessive caution necessary in this field.

Precaution against injury should be uppermost in the investigator's mind—yet he should remember that the carrying out of certain standard forms of safety measures may also act as a precaution against liability. The storage of high activity samples behind adequate lead shielding checked by a monitor device (either counter or electroscope) in all six planes of the storage cube is an essential precaution. It is wise to place the storage unit in such a way that no personnel are steadily exposed to it though many may be intermittently exposed to infinitesimal doses by passing the neighborhood of the storage area.

2 Insurance Closely related to the subject of precaution against liability is insurance. Insurance may be divided into those policies which protect the investigator and his institution against justified claims arising from injury to qualified personnel while working under standard safety measures and on the other hand those policies which are written to protect the investigator or institution from claims arising from personnel not qualified or not associated with the research who have suffered psychic trauma or imagined physical injury as result of proximity to the radiation source either during shipment storage or use.¹ A third type of policy should be mentioned—that which covers liability for real or imagined injury to patients who have received injections of radioactive materials either for study or treatment.

The use of radioactive materials is not widespread enough at present to fall into 'standard practice' and the range of liability is as yet undefined.

Of these three types of policy the first would appear to be the most essential. Late radiation injury might not manifest itself for years and workers who handle activities of any magnitude should be protected against the

¹ An example of the expense of such "public liability" policies may be gained from the fact that a premium of \$150 per shipment has been quoted for policy with limits of \$100,000 per individual payment and \$300,000 per total collection for any one suit. Property damage of \$5,000 per accident was included. This quotation was for K⁴⁰ in air transit. This premium may go up to \$1,500 if the consignee accepts full responsibility from the shipping point.

leaving only residual amounts in plasma though equilibrium is much more slowly attained. Isotopes injected as a part of organic compounds will, of course, follow the distribution of that compound or its breakdown products. Frequently considerable trial and error are necessary to establish the minimum dose which will yield satisfactory readings hours or days later when the measurements are made. In animal work the use of a minimum allowable dose is less important than in human studies though in either case the use of unnecessarily large radioactive doses constitutes a hazard to those injecting the original more-concentrated solution, and may in certain cases (Example iodine) actually alter the manner of utilization by direct radiation effect on the cells which take it up (58). In studies made with human beings the importance of avoiding overdosage in tracer studies is self-evident.

Time relationships as they affect dosage naturally depend on the relation of experiment-duration to half life of the material (Table I). The longer lived isotopes such as Fe^{59} , P^{32} , Ca^{45} , S^{35} , and C^{14} (Groups 3 and 4 Table I) present little problem. Those in Group 2 (Na^{24} , Br^{80} , K^{42}) present a real problem since inordinately high initial dosages may be necessary if the experiment is to last several half lives before end point measurements are made. With this group of isotopes very careful timing and dose calculation must be carried out to avoid high dosage and radiation effects on man or animal or on the other hand a failure from readings too close to background. In the short lived group (Cl^{38} , C^{11}) time looms larger than anything else in planning the dosage and conduct of the experiment. In both the latter groups of isotopes measurement techniques which concentrate the element in question or which employ crude extracts of large amounts of body fluid or tissue may help the investigator over the hurdle of short half life though when such methods are used careful account must be taken of self-absorption.

2 *Measurement* Just as the biologically important isotopes may be grouped according to their half lives so may they be grouped according to the energy of their beta rays and

TABLE II — RADIOACTIVE ISOTOPES OF COMMON BIOLOGICALLY IMPORTANT ELEMENTS ARRANGED ACCORDING TO ENERGY OF EMITTED PARTICLES

Element	Isotope	Particle energy in Mev (Max)	Gamma radiation Mev (Max)	
Hydrogen	H	0.015 e ⁻		Group 1. Radiation energy less than 1 Mev; technology of detection complex and still developmental.
Iron	Fe^{59}	0.06 Mev X-ray		
Carbon	C^{14}	1.45 e ⁻		Group 2. Radiation energy from 0.1 Mev to 1 Mev; technology of detection now available but close attention must be paid to problems of self-absorption, and special equipment may be necessary for accurate measurement.
Sulfur	S^{35}	0.70 e ⁻		
Calcium	Ca^{45}	0.20 e ⁻		
Zinc	Zn^{65}	(0.400 e ⁻) ¹	1.4	
Iron	Fe^{59}	0.60 e ⁻	3	
Bromine	Br^{80}	0.65 e ⁻	0.33	Group 3. Radiation energy over 1 Mev may be measured with ease on standard commercial equipment, hazards of handling "tracer" quantities greater than 1 Group 2 and
Sodium	Na^{24}	0.58 e ⁻	0.30	
Iodine	I^{131}	0.60 e ⁻	0.37	
Iodine	I^{130}	0.70 e ⁻	0.54	
Nitrogen	N^{13}	0.20 e ⁻	0.18	
Sodium	Na^{24}	0.4 e ⁻	0.73	
Phosphorus	P^{32}	0.60 e ⁻		
Oxygen	O	0.20 e ⁻		
Magnesium	Mg^{28}	0.60 e ⁻	1.0	
Carbon	C^{14}	1.40 e ⁻		
Potassium	K^{42}	1.58 e ⁻	1	
Chlorine	Cl^{38}	1.00 e ⁻	1	

¹Produced only on cyclotron; the present time particle emission is small fraction of disintegrations and therefore of little significance in measurement.

hence the ease and technique with which they may be measured (Table II). The "strong" group includes Na^{24} , K^{42} , Cl^{38} , P^{32} , I^{131} . These are easily quantitated with standard equipment readily obtainable. The middle group S^{35} , Ca^{45} , Fe^{59} require special attention to self-absorption counter or electroscopewindow thickness and methods of concentration, purification, precipitation or electroplating. The weak group H^3 , Fe^{59} present such problems in measurement that techniques are still in process of development and it is possible that the most practical and reliable have not yet

It will be observed in Tables I and II that many of the elements of weakest radiation have the longer half lives as a general rule half life and particle energy are inversely proportional. There are certain outstanding exceptions such as oxygen (O^{15}) and magnesium (Mg^{28}).

go up, down, or sideways it may never reach the counter window because of absorption in the universe of Na^{24} around it, or because it never started out with enough energy to get to the counter. It may be stopped in the counter window or, as a final insult it may pass through the counter so soon after its immediate predecessor that the counter itself has not recovered from the previous discharge in time to register its passage. It is therefore clear that all the electrons emitted by the Na^{24} do not cause a pulse to pass through the scaling circuit. When one considers that the absolute units of radiation intensity, the curie and the rutherford, are based on rate of disintegration it becomes clear that accurate quantitation of radioactive isotopes involves a measurement of the absolute disintegration rate of that material in terms of 'disintegrations per unit time. In dealing with ordinary counting equipment and under the geometrical conditions ordinarily employed this problem is one to confound the biologist and give pause even to the physicist.

A curie is defined as the quantity of radon in radioactive equilibrium with 1 gram of radium, and involves a disintegration rate of about $3.67 \pm 0.03 \times 10^{10}$ disintegrating atoms per second per gram of radium. This unit should properly not be applied to radioactive substances outside the radium family.¹ The rutherford is defined as that amount of any radioactive isotope which disintegrates at the rate of 10^6 disintegrations per second. Complicated physical techniques are required to measure the absolute disintegration rate of Na^{24} . However by the use of suitable standards calibrated with samples of known radioactive strength one may approximate for purposes of rough estimation just what a microcurie or a millirutherford, of Na^{24} will yield on one's own instrument in terms of counts per minute. The only importance which attaches to this has to do with radiation hazards. Successful biologic experiments may be carried through without any reference to absolute standards. Results may be expressed

The reader is referred to the much fuller discussion in the report, "Radioactivity Units & Standards," prepared by Professor Robley D. Evans, of the Massachusetts Institute of Technology for the National Research Council, Division of Physical Sciences, Committee on Radioactivity Subcommittee on Units, April 3, 1947.

In terms of the injected dose, or counting rate or in "units relative to uranium or other arbitrary standards or in any way which is clear and unequivocal. But it is important for the safety of both workers and subjects to know to a first approximation the absolute disintegration rate of the starting material for only in this way can the investigator relate his safety precautions to the experience of others.² This knowledge is probably easiest

*Calculation of the roentgen equivalence of systemically administered radioactive isotopes involves many pitfalls. The extent of tissue dilution, the phase volume of body water in which the isotope is diluted and specific tissue affinity are biologic variables which must be taken into account. The physical aspects of converting tissue dosage from beta rays into roentgens (units of radiation based on air ionization) are complex. In many instances only an approximation can be calculated for this conversion.

Two simple formulas have been derived by Prof. Robley D. Evans of The Massachusetts Institute of Technology which are quite useful in this connection. The first formula is an expression whereby one may calculate the daily dosage rate in roentgens per day (R) derived from an isotope which achieves an average tissue concentration (C) in millicuries per kilogram, and possessing an average particle energy (E_p) measured in MEV.

$$R = 60CE_{p^2} \quad (1)$$

It should be emphasized that R is a *massal* value; the formula is applicable when the isotope is dispersed through a mass of tissue large enough so that the mean beta ray path falls within the tissue surface is small compared to mass. For simple beta-ray spectra the average particle energy may be taken as $\frac{E_{max}}{3}$.

When a gamma ray is also involved, the roentgen equivalence is increased by 10-20 per cent. This formula is most useful in dealing with long half-lived materials.

When a short half life isotope is involved, the total dose is a more important calculation than the daily dose. Here the following formula applies:

$$D = .44 RT \quad (2)$$

where D is the total dose in roentgens, R the initial daily dose rate arrived at by formula (1) and T the half-period in days.

An example of this calculation may be illustrative. Suppose an 80 kgm. man is given 0.6 MC of K^{40} . The isotope may be considered as diluted in all of body water (60 liters). Then

$$R = \frac{(60CE_{p^2})}{3} =$$

$$R = 60 \times 0.01 \times \frac{1.5 \times 10^6}{3}$$

$$R = 0.857 \text{ roentgens per day (initial dosage rate).}$$

The factor ($\frac{1}{3}$) is the correction for the presence of a gamma ray. Since K^{40} is a short lived isotope (1.4 hours) the radiation delivered to tissue by the end of the first day is in the order of $\frac{1}{4}$ that being delivered at the outset, so the half life correction should be introduced, and the total dosage calculated:

$$D = 1.44 RT$$

$$D = 1.44 \times 0.857 \times 0.5$$

$$D = 0.62 \text{ roentgens total dose.}$$

This first approximation of the radiation dosage to which the patient has been subjected for study should be considered with the fact that the generally regarded safe limit is 0.6 roentgens per week. Thus the K. study could be repeated at weekly intervals indefinitely and fall within this margin of safety. Ordinary x ray exposures involve total radiation of 3-5 r for a chest fluoroscopy and film, 60-80 r for a gastrointestinal series.

These formulas are discussed more fully in the article by Professor Evans entitled "Dose Dosage in Radioisotope Therapy," *Am. J. Roentgen*, December 1947. The formulas were presented at the 1946 meeting of the American Roentgen Ray Society Symposium on Isotopes. The reader is also referred to the calculations described by W. E. Cohn in the Manhattan District Declassified Reports, 246, 95; July 4.

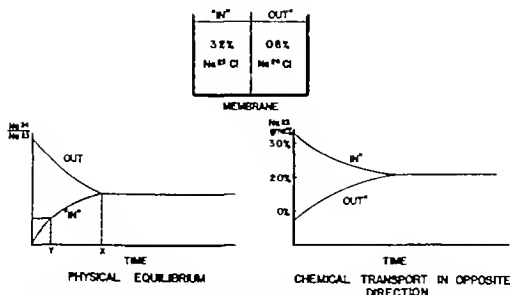


Fig. 2. Diagrammatic representation of a chemical situation in which physical (isotopic) equilibrium takes place despite net chemical transport in the opposite direction. Symbols and arrangements are as in Figure 1 except that the "In" compartment contains four times normal saline (3.2%) which produces an osmotic readjustment resulting in the net transport of sodium and chloride ions from "In" to "Out" before chemical equilibrium is re-established.

The addition of Na²⁴ to the "Out" compartment produces a movement of radioactive ions from "Out" to "In," exactly as in Figure 1.

It is clear that the radioactive data alone in such a situation might be most misleading as to the true nature of the chemical process taking place.

cate differences in permeability to sodium in the presence of 'bound' sodium which is not exchangeable or failure to achieve equilibrium in the time elapsed.

Much radioactivity research with ions has suffered from a lack of concomitant chemical analyses and, hence, an absence of specific activity data. Even in work with more complex organic compounds calculation of the specific activity will often reveal interpretative data not available from either physical or chemical analyses alone (10).

2 Physical equilibrium vs chemical transport If one were to make a gastric pouch and place therein a quantity of radioactive chloride sodium, or even deuterium the isotope would be seen to disappear from the pouch (4, 8, 9, 19). It would appear that the ion in question were being absorbed from the pouch. It was placed there and now it is there no longer—surely the cells are actively absorbing the substance in question.

Such is not necessarily the case. Even if the gastric mucosa were actively secreting HCl at the moment, the Cl³⁵ would still diminish both in total amount, concentration and specific activity. The fact is that the

Geiger counter and the cyclotron have put into our hands a means of detecting atomic quantities and we must no longer think in milligram terms when dealing with these unmeasurable weights.¹

It is a fundamental assumption of all research with isotopes that the living cell, just as the passive membrane cannot distinguish between isotopes of the same element. There appear to be a few interesting exceptions to this (Examples H², H³—or I¹³¹ in high concentration 40) but as a fundamental assumption it is sound. Therefore as mixing of atoms occurs a state of equilibrium develops in which unstable atoms are mixed with the same number of stable atoms in all parts of the system. The simplest example of this phenomenon is a unimolecular solution of ions free of all externally induced motion—an absolutely still beaker of KCl for example. This

¹In the most concentrated radioactive mixtures ordinarily available, only one-millionth or less of the atoms are unstable and capable of emitting radiation on stabilization. Only in the new "carrier free" products of nuclear fission have pure radioactive preparations of the man-made isotopes been produced; and even here, if half life is short and decay yields stable isotopes of the same element, radioactive purity will rapidly give way to diminishing specific activity. Long lived carbon C¹⁴ obtained from the Atomic Energy Commission contains about 3 per cent active atoms.

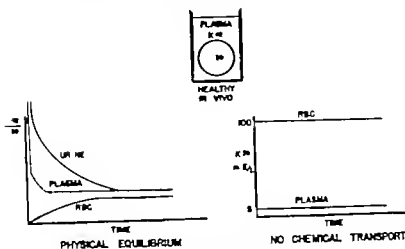


Fig. 3. Diagrammatic representation of a biological situation analogous to that shown in Figure 1. Although chemical equilibrium (stability) between potassium in the red cell and plasma is maintained by the peculiar properties of the viable erythrocyte, physical redistribution occurs following the addition of K^{42} to the plasma by intravenous injection. Such an injection upsets the proportional distribution of isotopes and, as a result of the permeability of the red cell membrane to potassium, equilibrium is re-established slowly. The nature of the curves suggests that a fraction of the potassium in the red cell is only slowly exchangeable with plasma potassium. Analyses either for K^{41} (chemical) or K^{42} (physical) do not reveal the nature of the events; only by simultaneous analyses for both may the situation be depicted.

system is, of course, not really motionless except at absolute zero as Brownian movement and infrared emission dissipate the thermal energy of the solution at room temperature. If it were possible to introduce into this apparently motionless system without disturbing it, a droplet of $K^{42}Cl$ the $K^{41}:K^{42}$ ratios in any area of the solution rapidly would become constant, as an expression of the attainment of physical equilibrium.

Early physicists who studied the difficulties of attaining and maintaining a vacuum stated that 'Nature abhors a vacuum.' This might be paraphrased to state that 'Nature abhors the separation of isotopes.' Energy must be expended to separate isotopes of the same element and given an opportunity to do so the separation will yield again to proportional distribution.

If the droplet of $K^{42}Cl$ introduced were in the form of a globule surrounded by a permeable membrane, and containing within it a KCl solution of exactly the same concentration

as that in the beaker the same equilibrium would occur. But the amount of KCl in the globule would not be altered. Physical equilibrium has taken place without chemical transport by way of analogy the radioisotope has disappeared from the gastric pouch without necessarily indicating any net absorption of sodium. Atoms have moved not milliequivalents. Actually the disappearance of K^{42} from the globule of KCl in the beaker is a measure of permeability to not transport of the ion, using the term 'transport' to mean the movement of enough atoms to alter the chemical concentration of the total isotope mixture on one side or the other of the membrane in question.

This confusion of physical equilibrium with chemical transport may be a source of error in the interpretation of results only by concomitant measures of radioactive and stable isotopes (i.e. physical and chemical analyses) and the calculation of specific activity may such confusion be avoided (Figures 1, 2, 3 and 4).

3. Phase measurements: The use of isotopes to measure areas of body water or the total

*This and the subsequent chart are based on work now in progress under contract with the Office of Naval Research and Harvard University.

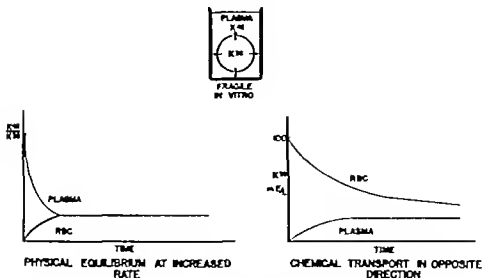


Fig 4. Diagrammatic representation of a biological situation analogous to that shown in Figure 2, and in contrast to that shown in Figure 3. The poorly preserved erythrocyte, *in vitro* is releasing its potassium as a preliminary (or accompaniment) of hemolysis. The K^+ added to the system still enters the red cell, and with an increased rate, as normal permeability relationships are upset by the "death" of the cell. As in Figure 2, net chemical transport (concentration or distribution alteration) is taking place in a direction opposite to that taken by the "tracer." Only by concomitant physical and chemical determinations may such a situation be revealed. It is of interest that the nonviable erythrocyte appears to have lost its non-exchangeable moiety of intracellular potassium.

amount of solid bodily constituents involves a simple concept, the formula for which is illustrated by analogy in Figure 6. The accuracy of this determination will depend upon the statistical accuracy of the "specific activity" figure employed in the final ratio in terms of Figure 6, the ratio of black to white apples in the fair sample taken after mixing.

This method may be used to serve three types of application in biological research. The first involves the use of nonisotopic materials for the measurement of fluid volumes; the second involves the use of isotopes for the measurement of fluid volumes; and the third embodies the use of isotopes to measure the total quantity of certain solid (ionic or elementary) constituents of the body.

In the measurement of areas of body fluid calculation depends upon the familiar formula for dilution

$$C_1 V_1 = C_2 V_2$$

where C_1 and V_1 represent the concentration and volume of solute in solvent before dilution and C_2 and V_2 after dilution. C_1 and V_2

are known to begin with. C_2 is measured after mixing and V_2 may be calculated

$$V_2 = \frac{C_1 V_1}{C_2}$$

The use of dyes to measure plasma volume is the earliest and most widely used application of this principle to biological work; it dates back to the work of Keith, Rowntree and Geraghty (41). When this method is used the "tracer" is detected by color instead of by radiation or weight and constitutes a tracer not because it resembles any of the normal constituents of the plasma (though Evans blue has colloidal properties not unlike albumin in aqueous solution) but because it is a dye which forms a nonpolar bond with plasma protein (largely albumin) at low temperatures (5, 57). It, therefore, in actuality measures the "albumin space," and its complex disappearance curve is partly the result of the fact that a significant moiety of plasma albumin circulates outside the plasma.

Ideally, the perfect tracer to use in measuring a body fluid space is an isotope of a normal constituent of that space which rapid

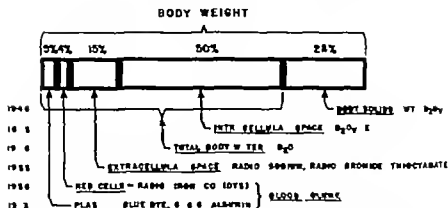


Fig. 5. Diagram illustrating some of the methods now available for the measurement of "phases" of the body fluids. References to the technical procedures involved are to be found in the text.

ly equilibrates in the total isotopic mixture and after an initial mixing phase presents a flat disappearance curve at any point in which a fair sample may be removed to determine C_2 and solve the equation for V_2 . Though the dye departs widely from this theoretical ideal its extensive use and study by Gibson, Gregersen and others has rendered it a highly useful device (2, 24, 27, 28, 37, 38).

The employment of thiocyanate ion is another nonisotopic application of this principle used to measure the volume of extracellular fluid available for thiocyanate solution (14, 20, 29). Thiocyanate is an anion similar in many respects to chloride and used in essence as a tracer for chloride. It is determined chemically by colorimetry. Like the dye, it is foreign to the body (though some individuals may carry basal concentration of 0.2 to 0.5 mgm per cent a fact which must be determined in all SCN space measurements) and in addition it is slowly removed and may be toxic in high concentration. Repeated determinations leave residual quantities in the serum which render each successive determination less accurate as the injected quantity constitutes a progressively lesser increment over the basal concentration.

The use of radioactive isotopes of iron (as hemoglobin synthesized in a donor who has been given the radio-iron) to measure the red cell mass is a theoretically perfect application of the tracer principle to a space measure-

ment (25, 26, 51, 55). The radioactive noncontaining red cells from the donor mix with the recipient's cells like the apples in the barrel; they do not escape into other compartments and the disappearance curve is essentially flat for long periods being affected only by cell destruction or the slow formation of new cells from dietary iron. From a practical standpoint the chemical processing to which the cells must be subjected prior to electroplating and the weak x-ray emitted by Fe^{59} which makes detection difficult contrive to render this method cumbersome although widespread investigative application is feasible.

The use of Na^{24} to measure the extracellular fluid—the sodium space—is practical and readily available (39, 69). From a theoretical point of view it is not perfect since after initial mixing the disappearance curve is not flat but drops slightly as sodium penetrates cells and is incorporated into bone. Just as with the dye-plasma method, this leakage of the tracer into another area may be compensated by adopting a standard sampling time early in the curve.

The use of deuterium for measurement of total body water is another "ideal" application of the tracer principle to body fluid space measurements (34, 35, 43, 49, 50, 54). Although deuterium has twice the mass of H^1 , this weight difference does not appear to interfere with applicability; the use of H^3 might be seriously hampered by this mass

change.¹ Deuterium exchanges with the exchangeable hydrogen in organic compounds as well as with H_2O but this amount is quantitatively so small as compared with the great volume of body water that it escapes measurement unless one isolates the end products of that exchange or the compounds synthesized by the body in the presence of deuterium rich H_2O . The physical apparatus necessary to measure plasma deuterium by gravimetric means is not complicated and the measurement of total body water by this technique is available now that D_2O has been released for general use by the Atomic Energy Commission.

The measurement of total solid constituents by the use of isotopes involves the same fundamental considerations, the concentration however, is not the radioactivity per unit volume of solvent but is instead the actual isotopic concentration—the radioactivity per unit weight of isotopic mixture—in short the specific activity (50). Thus C_1V_1 becomes the total radioactivity injected, C_2 the specific activity after equilibrium has occurred and V_2 the total amount (in terms of weight) of isotopic mixture in which the isotope has become mixed.

The measurement of total body sodium by this method consists in measuring the specific activity of the plasma sodium after equilibrium has been attained (24 to 36 hours) and dividing this ratio into the total activity injected at the outset. The urinary excretion should be subtracted from the injected activity the quantity excreted in the case of radiosodium is small.

Total body potassium may be measured by the same technique though urine excretion is significant and must be measured. The selection of what constitutes a fair sample of exchanged potassium is more complex. Studies now under way in this laboratory on K^{42} at equilibrium with K^{39} in the human body indicate that the urine specific activity after 30 hours represents exchange conditions throughout the body providing that dietary

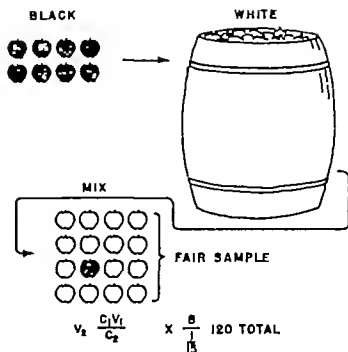


Fig. 6 An analogy devised to illustrate the principle involved in the determination of total exchangeable constituents by the tracer method.

The number of white apples in the barrel is unknown. A known number of black apples similar in size and shape the "tracers," are added to the system. Mixing is produced, and a "fair sample" is then removed for examination. The ratio of black to white apples is determined, and from this ratio the total number of apples in the barrel is calculated as shown.

In the biologic experiment, the unknown number of apples finds its analogy in the total quantity of ions to be measured. The "tracer" is the isotopic material to be mixed in the body. The "fair sample" is the tissue or fluid measurement made at equilibrium, and the ratio of black to white apples is the "specific activity" under equilibrium conditions. The final calculation consists in dividing the specific activity into the total activity present in the organism, to determine the total quantity of ion with which the isotope has exchanged.

K is limited prior to measurement of the urinary specific activity. The red cell originally conceived as a satisfactory barometer of the K^{42} / K^{39} ratio at equilibrium has been found to be unsatisfactory because of the apparent presence therein of nonexchangeable or slowly exchangeable potassium. Muscle, liver, plasma and urine are in equilibrium after 24 hours (16 18 22 53 70). Muscle and liver are of course not readily obtainable for sampling. Plasma, because of its low K^{39} content has low K^{42} values under conditions of physical equilibrium. The urine therefore constitutes the most readily available source of K for study of K^{42} / K^{39} ratios and calculation of total exchangeable K.

¹The work of Pace, et al. (J. Biol. Chem., 1947, 168, 459) employing "tritiated water" (HTO) to measure the total body water suggests that hydrogen of mass 3 is actually correct from a practical viewpoint despite the theoretical objection raised by the mass increment.

Dietary K finds a high representation in urinary K because the excretion rate of K is directly proportional to the plasma concentration over about 5 mE/L (71). For this reason the total body (exchangeable) K measurements must be made after a 12 hour K free fast—an overnight fast being sufficient for this purpose.

Methods for the measurement of total exchangeable nitrogen carbon sulfur and phosphorus could similarly be worked out in each case special problems of determining C_2 and the exact anatomicochemical extent of V_2 will arise and must be settled to establish the validity of the result¹.

The application of these measurements of total body constituents to the pressing problems of surgical nutrition and preoperative and postoperative care may lead us to a more quantitative concept of the needs of the surgical patient.

SUMMARY

1. Some practical problems relative to the biological use of isotopes are briefly discussed.

2. An increasing application of these methods to the problems of surgery may be expected in the future.

3. Such application will be most fruitful if adequate attention is paid to the fundamental biology of the problem at hand and to the basic considerations relative to all isotope research.

¹The work of Wintrobe and his group (*J. Biol. Chem.*, 1945, 165: 207) on the "labile iron pool," measured by the dilution of radioactive iron, represents an extension of this principle into the complex problem of iron distribution and metabolism, the measurement is essentially that of the "total exchangeable iron."

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THE RECTOGENITAL SEPTUM

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CAUDAL to the peritoneum of the rectovesical pouch in the male, the rectum and the bladder (together with seminal vesicles and prostate gland) are separated from one another by a relatively thin layer of tissue. In this tissue is found a membranous septum which is closely attached, by its cranial margin to the peritoneum at the bottom of the rectovesical pouch, and adheres, by its caudal end to the dorsal surface of the prostate gland. For this membrane the term of "rectovesical septum" has been in use for some time in conventional anatomy.

A similar septum is found almost without exception in the female between the rectum and the vagina in conformity with the nomenclature employed in the case of the male it should be called the rectovaginal septum. To denote the male and female septa collectively we will use in this article the term of rectogenital septum.

For several reasons this septum is of considerable importance. In the first place it separates the rectum from the bladder seminal vesicles, and prostate gland in the male, and from the vagina in the female. And furthermore it is to be counted among the structures which constitute the supporting mechanism of the genitourinary organs. Finally as will be discussed in another article this septum in combination with certain fascial sheets, effects a complete division of the subperitoneal space of the pelvic cavity into a dorsal or rectal compartment and into a ventral or urogenital compartment.

Concerning the nature of the rectogenital septum two opinions are in existence according to one of them it is of peritoneal origin while according to the other one it would be a purely fascial structure.

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Briefly the history of our knowledge of the rectogenital septum is as follows. The tissue between the rectum and bladder in the male was investigated first by Denonvilliers in 1836 hence urologists are still using the term

"Denonvilliers fascia" for this tissue in the male. Later on in 1899 two other French men Cuneo and Veau studied the "fascia prostatopentonealis" from an embryological point of view and arrived at conclusions which, in the opinion of the authors of the present article, are valid up to the present day. According to Cuneo and Veau the prostatopentoneal fascia (our rectovesical septum) is a peritoneal derivative and results from the fusion during embryological development of the ventral with the dorsal wall of the rectovesical pouch which in early embryological stages extends all the way down to the pelvic floor. In 1922 Miley B. Wesson reinvestigated the rectovesical septum and refuted the views advanced by Cuneo and Veau. On the basis of embryological studies this author claimed that the rectovesical septum is of fascial nature. The most recent publication on this subject is an article by Tobin and Benjamin and represents again an embryological investigation the results of which, however, were confirmative of the interpretation which Cuneo and Veau gave to the rectovesical septum.

Another quite recent article (1940) must be mentioned here. As we will see later on we have never had any difficulty either in the student dissecting room or in special dissections, to display the rectovaginal septum in the female cadaver. Curtis Anson and Benton however were evidently not able to find a rectovaginal septum. On p. 649 (2) they describe the tissue located between the rectum and the vagina as being composed of the fascial envelopes of rectum and vagina, with some "cellular tissue" intervening between them.

Since certain observations in adult cadavers seemed corroborative of the views of Cuneo and Veau, the senior author of this article has long been accustomed to teach the subject of the rectogenital septum to his students in the light of the studies made by these two French anatomists. Later on however when we became familiar with Wesson's article refuting the pentoneal theory of the rectovesical septum, we found it necessary to reinvestigate this problem and, more especially to record our observations by suitable illustrations. Since 1939 we have collected a large number of observations some of which will be reported in the present article.

It is our object to report, in the first place certain details which can easily be observed in adult cadavers and which can best be explained in the light of the pentoneal origin of the rectogenital septum. In the second place some observations in infants will be discussed which show that even during late intrauterine life the rectogenital pouch continues to recede from the rectogenital space.

OBSERVATIONS IN THE ADULT

Our attention was devoted mainly to the relation between the rectogenital septum and the peritoneum of the rectogenital pouch and further to the configuration of the peritoneum along a line corresponding to the attachment of the septum. But incidentally we also have made measurements to determine how far caudally the rectogenital pouch extends.

1 Caudal extent of rectogenital pouch It is generally assumed that in the female the rectovaginal pouch reaches down further caudally than the rectovesical pouch does in the male. On the average the bottom of the rectovesical pouch is said to lie 3 inches above the anus the bottom of the rectovaginal pouch only 2 inches. Because of the scarcity of female cadavers we had no opportunity to study the variations in the level of the rectovaginal pouch. In one female, illustrated in Figure 5 a colored woman 29 years old (479a, 1946), the bottom of the rectovaginal pouch was located 35 millimeters cranial to the ventral commissure of the anus. In another female cadaver (479a 1944), of a colored woman aged 35 years (see Fig 6), only the distance between

TABLE I.—VARIATION IN DEPTH OF RECTOVESICAL POUCH IN THE ADULT MALE¹

N. of specimen	Distance from bottom of rectovesical pouch to anterior anal commissure—mm.
1	58
2	70
3	
4	76
5	78
6	63
7	
8	75
9	74
10	78
11	58
12	58
13	
14	68
15	50
16	64
17	57
18	68
19	62
20	34
21	48
22	48
23	68
24	75
25	54
26	65
Greatest length	78.
Shortest length	34.
Mean length	63.1
Median length	50

¹The measurements were made by Mr. Allen Benson Spaulder January 24, 1947 in cadavers at the student laboratory.

the bottom of the pouch and the pelvic floor was measured, it was 58 millimeters, i. e. over 2 inches to conclude from this value the bottom of the rectovaginal pouch in this female must have been located nearly 3 inches cranial to the anus i. e. nearly twice the distance which it had in female 479a, 1946.

In males we have made a larger number of measurements. In Table I the cranial distances of the bottom of the rectovesical pouch from the ventral commissure of the anus, as measured in midsagittal section through the pelvis are listed for 23 male pelvises. One glance suffices to make one realize that the variability of this value is very considerable (from 34 to 78 mm.) Only in 6 among the 23 cases, the bottom of the rectovesical pouch was found 3 inches or slightly more (74 to 78 mm) cranial to the anus. In 8 cases the pouch was located only about 2 inches (from 48 to 58 mm) above the anus, and in 1 case this distance was only 34 millimeters (1½ inches) i. e. less than the assumed average in the female.

connective tissue. Moreover careful examination of the inner surface of the peritoneum at the bottom of the pouch failed to reveal any special features of this peritoneum, such as are found when a septum is present, and will be discussed in the following paragraphs.

In Figure 2, the right half of the pelvis of a white male, aged 69 years (4794, 1945) is illustrated. In this subject the bottom of the pouch was located well above the prostate gland. Attached to its outer surface is seen the rectovesical septum which could be displayed with great ease and perfectly clearly. As is always the case in the male it was separated from the rectum by a quantity of loose connective tissue which could be easily broken down with the finger. Ventrally it was more closely adherent to bladder and seminal vesicles from these structures it was raised with the aid of a blunt instrument as far caudal as the prostate gland. On the dorsum of the gland it faded away into the fascial capsule of this organ. Inspecting the peritoneum of the pouch on its inner (cranial) surface we observed running transversely and corresponding to the line of attachment of the rectovesical septum on the outside, a slightly grooved line of whitish color, which resembled a scar such as remains after a surgical suture. Along this line and on either side of it, the peritoneum was slightly wrinkled perpendicularly to the line. This configuration of the peritoneum is particularly conspicuous, as everywhere else in the pouch the peritoneum is perfectly smooth and devoid of irregularities. As is usually the case, the scar like line extended laterally on either side where the walls of the pouch rise along the lateral walls of the pelvis corresponding to a cranial continuation of the rectovesical septum into lateral peritoneal wings of the pouch. As has been described in another article (6) these lateral wings serve for the attachment of the peritoneal pouch to the visceral endopelvic fascia. The location and direction of the line both corresponding to the line of attachment of the rectovesical septum as well as the appearance of the peritoneum along this line leave no doubt that it represents the line along which the dorsal and ventral walls of the pouch fused with one another.

Another similar case but with the line of fusion even more conspicuous, is illustrated in Figure 3. It pictures the right half of the pelvis of a male negro (4794, 1945) aged 51 years (measurements recorded in Table II). The rectovesical pouch was located well above the prostate gland (25 mm) and a well developed rectovesical septum was present. Again a whitish scar like line was present on the inner surface of the pouch, which corresponded in location exactly to the line of attachment of the rectovesical septum on the outside. In this case the whitish line was even more conspicuous than it was in the previous case, as it was more irregular and crossed in several places by cord like thickenings of the peritoneum. From its midpoint in the median sagittal plane it extended laterally on either side for a distance of 41 millimeters having thus a total length of about $3\frac{1}{2}$ inches.

There is another feature which is shown in this illustration. We made a special attempt in the dissection of this pelvis to ascertain the relation between the rectovesical septum and the fascial capsules of rectum and bladder. As is shown in the illustration, each of the three membranous structures was dissected and displayed individually. As in the previous case the rectovesical septum was closely adherent to the bladder and prostate gland but was separated from the rectum by loose connective tissue. It could be followed as an individual sheet of tissue all the way down to the pelvic floor. Cranially it was continued without any discernible boundary or change in texture into the peritoneum of the rectovesical pouch. With similar distinctness we were able to display the fascial capsules of the rectum dorsally and of the bladder and prostate gland ventrally. Contrary to the description given by Curtis Anson and Beaton for the female pelvis the rectovesical septum is a structure additional to and independent of, the fascial capsules of the adjacent viscera. Attention should be called also to a condition of the capsule on the ventral surface of the rectum which we have encountered in many other cases. The ventral capsule of the rectum as shown in Figure 3 was attached cranially to the peritoneum of the rectovesical pouch slightly above the line of attachment of the

septum. From this level on cranially the ventral capsule of the rectum. If there was one could not be displayed gross anatomically as a layer independent of the peritoneal covering of the rectum. In connection with this condition it should be pointed out that the rectovesical septum could be distinguished clearly from the fascial capsules as will be referred to again; its texture and color were different from those of the fascial sheets.

In Figure 4 (4794 & 1945) an extreme case of the "scar" at the bottom of the rectovesical pouch is illustrated (for measurements see Table II). In this subject a colored male aged 47 years this line extended far laterally rising up cranially along the lateral wall of the pouch where on the outside a well developed lateral peritoneal wing was attached to the pouch. Its line of attachment corresponding exactly to the location of the linear "scar." While elsewhere in the pouch the peritoneum showed a perfectly smooth surface it was thrown along the whitish line into many wrinkles and coarse folds running perpendicular to the line and creating the impression that some secondary processes of reorganization had taken place in this region during development. In addition a series of strong peritoneal cords had developed which were running in dorsoventral direction bridging over the line of fusion. Obviously these cords must have had the effect of re-enforcing the line of fusion preventing a secondary splitting of the septum into its two original layers. Seeing this line and its accessory formations in a specimen as the one described above one could not be in doubt that the rectovesical septum is the result of fusion of the dorsal and ventral wall of the rectovesical pouch with one another. This line corresponds exactly to the line of attachment of the septum; it is the only place in the pouch where the peritoneum is not smooth and the peritoneal structures developed along this line have the effect of preventing a reopening of the fused portion of the pouch.

The rectovaginal septum of the female pelvis is illustrated in Figure 5 picturing the left half of the pelvis of a colored female (4901046) aged 29 years. In this subject however the mode of attachment of the septum to the peritoneum differed from the specimens de-

scribed previously. The peritoneum at the bottom of the pouch was carefully examined but neither the whitish "scar" nor any signs of processes of reorganization could be detected. The cranial end of the septum was split into two leaves: a ventral and a dorsal leaf each of these was attached separately, the ventral leaf was continued without discernible boundary into the ventral and dorsal wall, respectively of the rectovaginal pouch. Across the gap between the two limbs, the peritoneum of the pouch had grown as a continuous peritoneal partition separating the space of the gap from the peritoneal cavity and at the same time re-enforcing the line of fusion in the middle as a binder. Obviously this is only a special case of the peritoneal cords. Instead of cord separated from one another by varying intervals the peritoneum had grown over the gap between the two leaves of the septum as a single continuous sheet.

As in the male, the fascial capsules of the viscera adjacent to the septum could be displayed as structures entirely separate from the septum (Fig. 5). Moreover as in the males, the ventral capsule of the rectum was attached cranially to the peritoneum of the pouch and could not be demonstrated cranial to this level as an individual layer. As the illustration shows the same condition existed with respect to the capsule of the vagina beyond the level of its attachment to the peritoneum of the pouch over the body and fundus of the uterus, no individual capsule could be demonstrated a condition which, however, is well known.

We observed in this specimen before a dissection was made that the rectovaginal septum passed from its cranial attachment forward to the dorsal wall of the vagina which it was closely adherent while distal it was separated from the rectum by a considerable space filled in with loose connective tissue. When the uterus and with it the vagina were pulled forward the septum followed the vagina; it was not held to the rectum. The close relationship of the septum to the genitourinary viscera in both sexes is of considerable importance. If a finger is introduced through a transverse perineal incision prepared for creating access to the pelvic viscera the open-

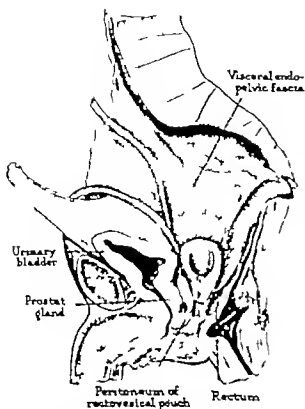


Fig. 1 Right half of pelvis of a male negro (47949, 1943) 60 years of age seen in medial view. A case in which the rectovesical pouch descended as far caudal as the middle of total length of dorsal surface of prostate gland and in which the rectovesical septum was missing.

ator may feel reasonably certain that his finger will be separated from the genitourinary organs by the rectogenital septum but will be in immediate contact with the ventral capsule of the rectum.

In Figure 6 a dorsal dissection of the pelvis of a colored female (47934, 1944) aged 35 years is illustrated. The coccyx and levator ani as well as the rectum had been removed. Both the ventral and dorsal fascial capsules of the rectum and their lateral expansions are still visible. The dorsal wall of the rectovaginal pouch and the rectovaginal septum are exposed to view. The rectovaginal septum was incised longitudinally and reflected to either side; this manipulation exposed the dorsal capsule of the vagina; upon incision and retraction of it the musculature of the vagina came into view.

By undermining the space between the septum and the vaginal capsule and the space between the rectal capsule and the septum the latter could be followed all the way down

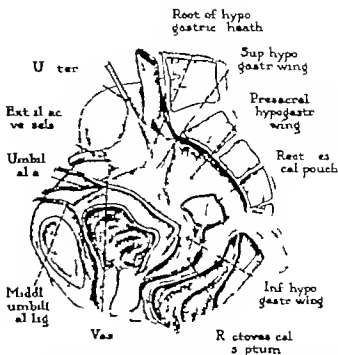


Fig. 2 Right half of pelvis of a white male (47944, 1945) aged 60 years. Peritoneum has been removed every where except for the rectovesical pouch and septum. The hypogastric sheath is seen in its entire extent. The vas deferens passes across the superomedial surface of the superior hypogastric wing and is thus excluded from the space of Retzius. (This figure is same as Figure 6a in article entitled "Visceral Endopelvic Fascia," *Surg Gyn Obst* 94:8 86-9-28.)

to the pelvic floor its length from the line of attachment to the pouch down to the pelvic floor was 58 millimeters (as compared to 30 millimeters in the female discussed previously).

At first we were unable to see a boundary line between the septum and the dorsal peritoneum of the pouch. From outside the two looked alike but could be distinguished from the fascial sheets. Gradually as the specimen was worked on and the peritoneum and septum were pulled and stretched in different directions a faint line which gradually became more pronounced was discovered; it was crossed by a number of what appeared to be fascial strands. Even then complete certainty could not be obtained until we introduced the handle of a scalpel through an incision in the dorsal wall of the pouch; this procedure permitted exploration of the pouch and exact determination of the line along which the septum was attached to the pouch.

Exactly as inspection of midsagittal sections complete dissection from the dorsal side

septum. From this level on cranially the ventral capsule of the rectum. If there was one could not be displayed gross anatomically as a layer independent of the peritoneal covering of the rectum. In connection with this condition it should be pointed out that the rectovesical septum could be distinguished clearly from the fascial capsules as will be referred to again. Its texture and color were different from those of the fascial sheets.

In Figure 4 (479, 4 1945) an extreme case of the scar at the bottom of the rectovesical pouch is illustrated (for measurements see Table II). In this subject a colored male aged 47 years, this line extended far laterally rising up cranially along the lateral wall of the pouch where on the outside a well developed lateral peritoneal wing was attached to the pouch. Its line of attachment corresponding exactly to the location of the linear scar. While elsewhere in the pouch the peritoneum showed a perfectly smooth surface it was thrown along the whitish line into many wrinkles and coarse folds running perpendicular to the line and creating the impression that some secondary processes of reorganization had taken place in this region during development. In addition a series of strong peritoneal cords had developed which were running in dorsoventral direction bridging over the line of fusion. Obviously these cords must have had the effect of re-enforcing the line of fusion preventing a secondary splitting of the septum into its two original layers. Seeing this line and its accessory formations in a specimen as the one described above one could not be in doubt that the rectovesical septum is the result of fusion of the dorsal and ventral walls of the rectovesical pouch with one another. This line corresponds exactly to the line of attachment of the septum. It is the only place in the pouch where the peritoneum is not smooth and the peritoneal structures developed along this line have the effect of preventing a re-opening of the fused portion of the pouch.

The rectovaginal septum of the female pelvis is illustrated in Figure 5 picturing the left half of the pelvis of a colored female (479a 1946) aged 39 years. In this subject however the mode of attachment of the septum to the peritoneum differed from the specimens de-

scribed previously. The peritoneum at the bottom of the pouch was carefully examined but neither the whitish "scar" nor any signs of processes of reorganization were detected. The cranial end of the septum split into two leaves, a ventral and a dorsal leaf each of these was attached separately. The ventral leaf was continued without discernible break into the ventral and dorsal wall, respectively of the rectovaginal pouch. Across the gap between the two limbs, the peritoneum of the pouch had grown as a continuous peritoneal partition separating the space of the gap from the peritoneal cavity and, at the same time re-enforcing the line of fusion in the manner of a binder. Obviously this is only a special case of the peritoneal cords. Instead of cords related from one another by varying intervals the peritoneum had grown over the gap between the two leaves of the septum as a single continuous sheet.

As in the male the fascial capsules of the viscera adjacent to the septum could be displayed as structures entirely separate from the septum (Fig. 5). Moreover as in many males the ventral capsule of the rectum was attached cranially to the peritoneum of the pouch and could not be demonstrated cranial to this level, as an individual layer. As the illustration shows the same condition existed with respect to the capsule of the vagina beyond the level of its attachment to the peritoneum of the pouch over the body and fundus of the uterus no individual capsule could be demonstrated a condition which however is well known.

We observed in this specimen before a dissection was made that the rectovaginal septum passed from its cranial attachment forward to the dorsal wall of the vagina to which it was closely adherent while dorsally it was separated from the rectum by a considerable space filled with loose connective tissue. When the uterus and with it the vagina were pulled forward the septum followed the vagina. It was not held to the rectum. This close relationship of the septum to the genitourinary viscera in both sexes is of considerable importance. If a finger is introduced through a transverse perineal incision prepared by creating access to the pelvic viscera the rect-

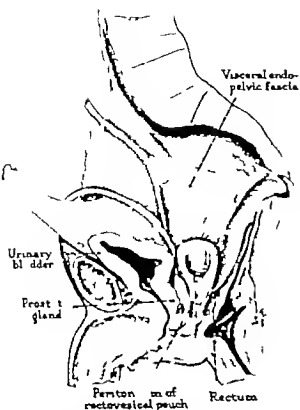


Fig. 1 Right half of pelvis of a male negro (4790, 1943) 60 years of age seen in medial view. A case in which the rectovaginal pouch descended as far caudal as the middle of total length of dorsal surface of prostate gland and in which the rectovaginal septum was missing.

ator may feel reasonably certain that his finger will be separated from the genitourinary organs by the rectogenital septum but will be in immediate contact with the ventral capsule of the rectum.

In Figure 6 a dorsal dissection of the pelvis of a colored female (4791, 1944) aged 35 years is illustrated. The coccyx and levator ani as well as the rectum had been removed. Both the ventral and dorsal fascial capsules of the rectum and their lateral expansions are still visible. The dorsal wall of the rectovaginal pouch and the rectovaginal septum are exposed to view. The rectovaginal septum was incised longitudinally and reflected to either side. This manipulation exposed the dorsal capsule of the vagina. Upon incision and retraction of it the musculature of the vagina came into view.

By undermining the space between the septum and the vaginal capsule and the space between the rectal capsule and the septum the latter could be followed all the way down

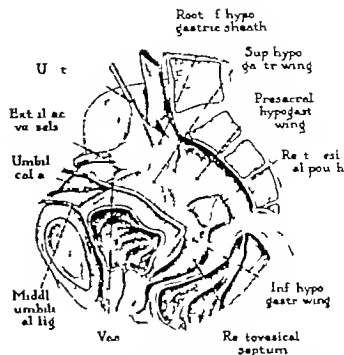


Fig. 2 Right half of pelvis of a white male (4794, 1945) aged 60 years. Peritoneum has been removed everywhere except for the rectovaginal pouch and septum. The hypogastric sheath is seen in its entire extent. The vas deferens passes across the superomedial surface of the superior hypogastric wing and is thus excluded from the space of Retzius. (This figure is same as Figure 6a in article entitled "Visceral Endopelvic Fascia," *Surg Gyn Obst.*, 1948, 86, 9-28.)

to the pelvic floor. Its length from the line of attachment to the pouch down to the pelvic floor was 58 millimeters (as compared to 30 millimeters in the female discussed previously).

At first we were unable to see a boundary line between the septum and the dorsal peritoneum of the pouch. From outside the two looked alike but could be distinguished from the fascial sheets. Gradually as the specimen was worked on and the peritoneum and septum were pulled and stretched in different directions a faint line which gradually became more pronounced was discovered. It was crossed by a number of what appeared to be fascial strands. Even then complete certainty could not be obtained until we introduced the handle of a scalpel through an incision in the dorsal wall of the pouch. This procedure permitted exploration of the pouch and exact determination of the line along which the septum was attached to the pouch.

Exactly as inspection of midsagittal sections complete dissection from the dorsal side

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In Figure 4 (479 & 1045) an extreme case of the "scar" at the bottom of the rectovesical pouch is illustrated (for measurements see Table II). In this subject a colored male aged 47 years this line extended far laterally rising up cranially along the lateral wall of the pouch where on the outside a well developed lateral peritoneal wing was attached to the pouch its line of attachment corresponding exactly to the location of the linear "scar". While elsewhere in the pouch the peritoneum showed a perfectly smooth surface it was thrown along the whitish line into many wrinkles and coarse folds running perpendicular to the line and creating the impression that some secondary processes of reorganization had taken place in this region during development. In addition a series of strong peritoneal cords had developed which were running in dorsoventral direction bridging over the line of fusion. Obviously these cords must have had the effect of re-enforcing the line of fusion preventing a secondary splitting of the septum into its two original layers. Seeing this line and its accessory formations in a specimen as the one described above one would not be in doubt that the rectovesical septum is the result of fusion of the dorsal and ventral walls of the rectovesical pouch with one another. This line corresponds exactly to the line of attachment of the septum. It is the only place in the pouch where the peritoneum is not smooth and the peritoneal structures developed along this line have the effect of preventing a re-opening of the fused portion of the pouch.

The rectovaginal septum of the female pelvis is illustrated in Figure 5 picturing the left half of the pelvis of a colored female (4,90 1046) aged 29 years. In this subject however the mode of attachment of the septum to the peritoneum differed from the specimens de-

scribed previously. The peritoneum at the bottom of the pouch was carefully examined but neither the whitish "scar" nor any signs of processes of reorganization were detected. The cranial end of the septum split into two leaves a ventral and a dorsal leaf each of these was attached separately and was continued without discernible break into the ventral and dorsal wall, respectively of the rectovaginal pouch. Across the gap between the two limbs the peritoneum of the pouch had grown as a continuous peritoneal partition separating the space of the gap in the peritoneal cavity and at the same time re-enforcing the line of fusion in the same a binder. Obviously this is only a special case of the peritoneal cords. Instead of cords isolated from one another by varying intervals the peritoneum had grown over the gap between the two leaves of the septum as one single continuous sheet.

As in the male the fascial capsules of the viscera adjacent to the septum could be displayed as structures entirely separate from the septum (Fig. 5). Moreover as in the males, the ventral capsule of the rectum was attached cranially to the peritoneum of the pouch and could not be demonstrated cranial to this level as an individual layer. As the illustration shows, the same condition existed with respect to the capsule of the vagina beyond the level of its attachment to the peritoneum of the pouch over the body and fundus of the uterus no individual capsule could be demonstrated a condition which however is well known.

We observed in this specimen before a dissection was made that the rectovaginal septum passed from its cranial attachment forward to the dorsal wall of the vagina which it was closely adherent while dorsally it was separated from the rectum by a considerable space filled so with loose connective tissue. When the uterus and with it the vagina were pulled forward, the septum followed the vagina. It was not held to the rectum. The close relationship of the septum to the genitourinary viscera in both sexes is of considerable importance. If a finger is introduced through a transverse perineal incision, preparatory to creating access to the pelvic viscera the

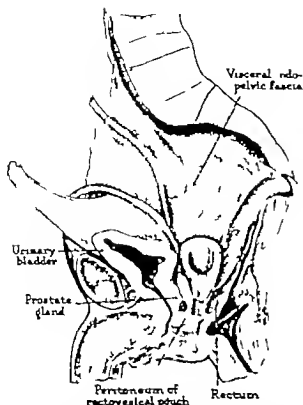


Fig 1 Right half of pelvis of a male negro (4790, 1945) 60 years of age, seen in medial view. A case in which the rectovaginal pouch descended as far caudal as the middle of total length of dorsal surface of prostate gland and in which the rectovaginal septum was missing

ator may feel reasonably certain that his finger will be separated from the genitourinary organs by the rectogenital septum but will be in immediate contact with the ventral capsule of the rectum

In Figure 6 a dorsal dissection of the pelvis of a colored female (4791, 1944) aged 35 years is illustrated. The coccyx and levator ani as well as the rectum had been removed. Both the ventral and dorsal fascial capsules of the rectum and their lateral expansions are still visible. The dorsal wall of the rectovaginal pouch and the rectovaginal septum are exposed to view. The rectovaginal septum was incised longitudinally and reflected to either side; this manipulation exposed the dorsal capsule of the vagina. Upon incision and retraction of it the musculature of the vagina came into view.

By undermining the space between the septum and the vaginal capsule and the space between the rectal capsule and the septum the latter could be followed all the way down

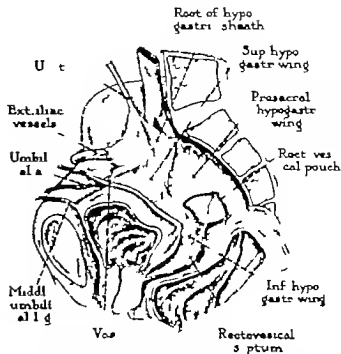


Fig 2 Right half of pelvis of a white male (4790, 1945) aged 60 years. Peritoneum has been removed everywhere except for the rectovaginal pouch and septum. The hypogastric sheath is seen in its entire extent. The vas deferens passes across the superomedial surface of the superior hypogastric wing and is thus excluded from the space of Retzius. (This figure is same as Figure 6a in article entitled "Visceral Endopelvic Fascia," *Surg Gyn Obs* 94:8 86 9-28.)

to the pelvic floor; its length from the line of attachment to the pouch down to the pelvic floor was 58 millimeters (as compared to 30 millimeters in the female discussed previously).

At first we were unable to see a boundary line between the septum and the dorsal peritoneum of the pouch. From outside the two looked alike but could be distinguished from the fascial sheets. Gradually as the specimen was worked on and the peritoneum and septum were pulled and stretched in different directions, a faint line which gradually became more pronounced was discovered; it was crossed by a number of what appeared to be fascial strands. Even then complete certainty could not be obtained until we introduced the handle of a scalpel through an incision in the dorsal wall of the pouch; this procedure permitted exploration of the pouch and exact determination of the line along which the septum was attached to the pouch.

Exactly as inspection of midsagittal sections, complete dissection from the dorsal side

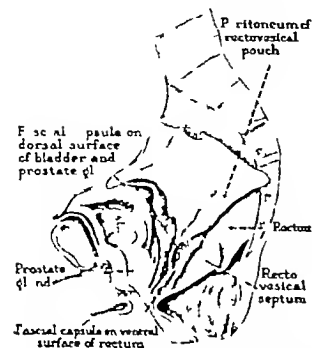


Fig. 4. Right half of the pelvis of male seen from the medial view. Not the line of transverse crease in the bottom of the rectovaginal pouch and several wrinkles in the peritoneum, running perpendicular to the line. Others that the fascial capsule of the rectum and that of the bladder and prostate are practically independent of the rectovesical septum. (Illustrated by J. H. L. M. M.)

lead to the conclusion that the rectovaginal septum is a structure of real existence that it is continuous with the peritoneum of the rectovaginal pouch but is entirely independent and different from the fascial capsules of the adjacent pelvic viscera.

3. *Eccentricities of the rectovaginal septum*
The cases of rectovaginal septum discussed in the preceding paragraphs were especially selected because they are among those which have a bearing on the developmental origin of the septum. Many similar examples have been found over a period of many years in the student dissecting room and in special dissections. These cases, however, do not convey an idea of the great variability of the septum with respect to its completeness. It has already been mentioned that in rare cases the septum may be entirely missing. But there are instances in which the septum is perforated by holes in a varying degree and other instances in which it no longer impresses a

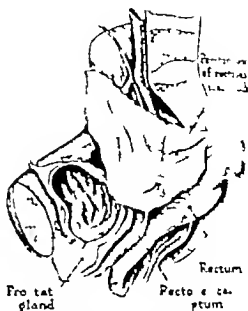


Fig. 4. Right half of pelvis of male seen from the medial view. Not the line of transverse crease across the bottom of the rectovaginal pouch, others the fold and lines of the peritoneum along the sac and peritoneal coat behind it.

sheet but consists of a number of separate narrow strips which become very thin caudally and fade away on the bladder, prostate gland or vagina. This variability in completeness explains some of the differences of description found in the literature as well as the failure of some authors to find such a septum.

Nevertheless if a well developed septum is present it can be easily distinguished by gross examination from the surrounding fascial sheets. The fascial sheets of the visceral capsules while they represent definite membranous envelopes nevertheless evoke upon touch the feeling of a more loosely woven material of felt like nature. The surfaces of these capsules are rough, of whitish color and of irregular appearance. The septum on the contrary does not feel fibrous; it feels to the touch like a smooth and firm, densely woven material. Moreover in many cadavers the surface of the septum has a distinct tinge of pinkish bluish tint. In several instances the septum stood out prominently as a faint but bluish greenish color similar to that of the bladder, however, we are uncertain concerning the source of this pigment.

In the male cadaver 47941 1945 (illustrated in Fig 2) the pouch, together with the cranial half of the septum, was removed placed in alcohol and examined later under a binocular dissecting scope. The outer surface of the septum and of the peritoneum of the pouch was covered by a thin layer of brownish colored areolar tissue of loose texture through which the peritoneum and septum could be seen in many places. After this outer layer had been removed, the surface of the remaining parts appeared slightly bluish to the naked eye. The septum consisted of coarse flat ribbon like fibers of considerable width and of a bluish and glistening surface they were wrinkled cross-wise as if they had shrunk by retraction of some elastic material within them. All of these fibers were running in cranio-caudal direction (from the pouch toward the pelvic floor) and were arranged in two layers easily separable from one another. The fibers of each layer were continued upon the outer surface of the corresponding wall of the pouch, where they gradually faded away in the peritoneum. Close to the bottom of the pouch these fibers were more densely placed than farther caudally many of them however extended through the whole length of the septum as far caudal as the cut edge of the septum where they were cut off. The spaces between the fibers were filled in by a delicate and transparent loose connective tissue.

In many instances the rectogenital septum may be easily and neatly split into a dorsal and a ventral leaf. Thus we have demonstrated to our students for many years and we advise them routinely to attempt a separation of the septum into its two original layers. Pelvis that have been halved by a midsagittal section are especially suitable for this purpose. Running the handle of a scalpel repeatedly along the white line on the inner surface of the pouch and exerting at the same time cautious pressure will frequently accomplish the desired result. In cases of the presence of peritoneal cords bridging over the scar these cords must be carefully cut through. In the dorsal dissection illustrated in Figure 6 an attempt to split the septum was made and succeeded very easily.

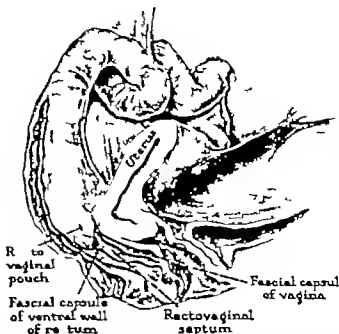


Fig 5 Part of left half of pelvis of colored female, picturing rectovaginal septum and its relationship to capsules of rectum and vagina. Peritoneum left intact. (This is same as Figure 2 in article entitled "Visceral Endopelvic Fascia" *Surg Gyn Obst* 1948, 86 9-28.)

It seems that under certain conditions splitting of the septum and reopening of the pouch can occur in life. In this connection a report published by J M H Rowland in 1926 on a case of extrauterine pregnancy is of interest. The embryo developed entirely in the peritoneal cavity dorsal to the uterus. At term the head of the child which was delivered by cesarean section was found in the pouch of Douglas where it had moved all the way down to the floor of the pelvis. No break in the peritoneal lining of the pouch was found. The weight of the fetus evidently had split and separated the two layers of the septum thus reopening the pouch to its original caudal extent.

OBSERVATIONS IN INFANTS

Of the infants which we examined 37 will form the subject of this article.

Only in a single one (dissection 48 1946 colored female Infant full term dissected by Dr R M Cunningham) of these 37 infants did the rectogenital pouch extend all the way down to the pelvic floor. It was dissected from the dorsal side after removal of the sacrum coccyx and rectum together with the dorsal

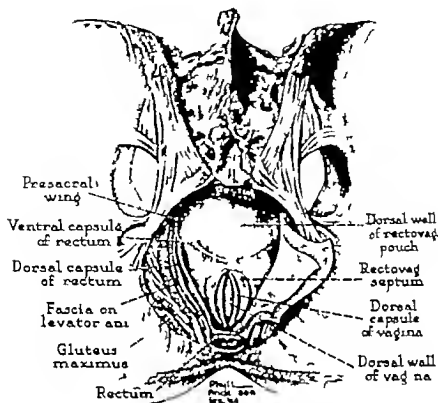


Fig 6 Dorsal dissection of pelvis of colored female (4799, 1943) aged 35 years. Coccyx, levator ani, and rectum have been removed. Dorsal and ventral leaves of fascial capsule of rectum were incised longitudinally. On the left side they are shown cut away; on the right side they are reflected to the right. The rectovaginal septum is seen from its dorsal aspect through longitudinal slit in the capsule and muscular wall of the vagina are visible.

wall of the rectovaginal pouch, the ventral wall of the pouch was exposed in a dorsal view (Fig 7). The peritoneum is seen to cover the entire dorsal wall of the vagina from which it is reflected at the level of the pelvic floor. While this infant does not represent an early fetal stage (it is a full term baby) it is noteworthy that we have never encountered this condition in adult cadavers.

Of the remaining 36 infants which are recorded in Tables III and IV we made measurements to ascertain the level of the bottom of the pouch in relation to certain landmarks. In both sexes—there were 20 males and 16 females—four measurements were taken from each specimen. The landmarks which were used as measuring points, are shown diagrammatically in Figures 8 and 9.

In not one of the 36 recorded infants did the peritoneal pouch extend to the floor of the pelvis although the youngest among them were only 6 months intrauterine age and with few exceptions, a rectogenital septum was already present resembling the rectogenital septum of the adult. In Figure 10 (4799, 1943) a sagittal section through the pelvis of a representative case is illustrated. The rectovaginal pouch is seen as well as the rectovaginal septum which was continued uninterrupted into the peritoneum at the bottom of the pouch. In Figure 11 (4799, 1943) a sagittal section through the pelvis of a male infant is illustrated, in which no septum was present. From the ventral wall of the rectovaginal pouch a hollow spur was projecting in caudal direction. It is possible that this was the beginning of the proc-

esses leading ultimately to the formation of the septum. This infant, however, did not represent a particularly early stage; its intrauterine age was 7 8 months and its crown-rump length 26.5 centimeters. The bottom of the pouch extended unusually far caudally; it was situated below the level of the caudal end of the prostate gland. As has been mentioned, there are few adults in which the septum is missing (Fig. 1).

In Figure 12 a midsagittal section through the pelvis of a male infant (479²⁸ 1943) is diagrammatically illustrated among the 20 male infants recorded in Table III; it was one of the two in which the rectovesical pouch extended closest to the ventral commissure of the anus, the other one being 479²⁸. Neither of these two infants was among the earliest stages; one of them (No. 30) was 7.5 months, the other one 7.8 months intrauterine age.

In Figure 13 (479²⁸ 1943) a similar sketch is presented of the pelvis of a female infant in which the rectovaginal pouch extended farther caudally than in any of the other female infants recorded in Table IV; again it was not one of the youngest female infants (8.1 months intrauterine age as against 6 months in the youngest infant).

The variation of the value expressing distance of the bottom of the rectogenital pouch from the anus is very considerable, and since as mentioned (Tables I and II) there is also great variability of this value in the adult, it is very difficult to feel certain as to the sig-

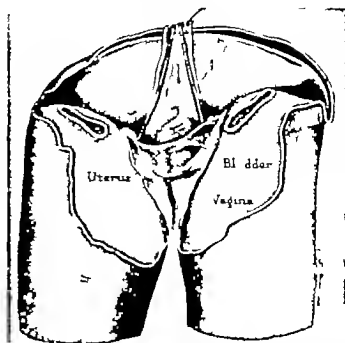


Fig. 7. Pelvis of a female infant (dissection 48, 1930) colored, born at term, seen in a dorsal view after the sacrum, coccyx and rectum had been removed. The dorsal wall of the vagina, incised longitudinally, is seen. It is covered in its full length with peritoneum. The rectovaginal pouch extended fully to the floor of the pelvis.

nificance of these variations in the infant. Attention should be called, however, to the fact that in a general way the pouch of both sexes extended farther caudally in infants born one or several months before term than in those which were born close to or at term.

But there is another line of evidence which suggests rather forcefully that a retraction of the rectogenital pouch in both sexes does take

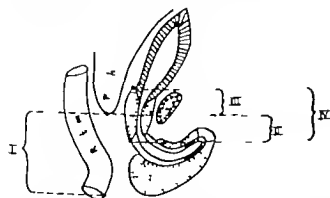


Fig. 8. Diagrammatic midsagittal section through pelvis of male infant, showing landmarks which were used in four routine measurements. I Distance of bottom of rectovesical pouch, cranial to ventral commissure of anus. II Distance of bottom of rectovesical pouch cranial to apex of prostate gland. III Distance of bottom of rectovesical pouch, caudal to base of prostate gland. IV Length of dorsal surface of prostate gland.



Fig. 9. Diagrammatic midsagittal section through pelvis of female infant, showing landmarks which were used in four routine measurements. I Distance of bottom of rectovaginal pouch, cranial to ventral commissure of anus. II Distance of bottom of rectovaginal pouch, caudal to dorsal fornix of vagina. III Distance between dorsal fornix of vagina and dorsal commissure of opening of vagina (length of vagina). IV Distance between dorsal fornix of vagina and external orifice of cervix (length of intravaginal portion of cervix).

at least in some cases, even after birth. It has been stated in the adult male the rectovesical pouch extends rarely below the level of the cranial end of the prostate gland and in the adult female only a narrow strip along the cranial end of the dorsal vaginal wall is covered with peritoneum.

But in infants ranging from 6 months intra-uterine age to full term (Tables III and IV), large portions of both prostate gland and dorsal vaginal wall may be covered by the peritoneum of the rectogenital pouch. In the male infants the bottom of the rectovesical pouch was located only in a single case cranial to the base of the prostate gland, and this was one of the older infants (8 5 months of intra-uterine age). In the other 19 cases the pouch



Fig. 2. Rectovesical pouch of negro female infant as it appeared in medial view. For measurements see Table III.

TABLE III—DEPTH OF RECTOVESICAL POUCH IN MALE INFANTS (in mm.)

Series 479a-m 943

(For method of measurement see Fig. 3)



Fig. 11. Left half of the pelvis of male infant (4790, 1043) of 7.8 months' intrauterine age. Rectovesical pouch descends as far caudal as to the level of caudal end of prostate gland. Instead of a rectovesical septum a hollow spur projects caudally from the ventral wall of rectovesical pouch. For measurements see Table I. A Rectovesical pouch, B peritoneum, C intestinal canal, D longitudinal musculature of rectum, E internal sphincter of anus, F external anal sphincter, G bladder, H prostate gland, I pubococcygeus muscle, A central perineal body, L symphysis pubis, M bulb of urethra, N bulbocavernosus muscle.

extended caudally to a level corresponding to 15—100 per cent of total length of dorsal surface of the prostate gland in 3 of these cases the bottom of the rectovesical pouch was located even caudal to the lower end of the prostate gland. In the 16 female infants recorded in Table IV 19—57 per cent of total length of dorsal vaginal wall was covered with peritoneum and in 1 female infant illustrated in Figure 7 the entire length of the vagina was covered with the peritoneum of the ventral wall of the rectovaginal pouch.

Moreover the measurements suggest that during late intrauterine life the process of fusion of the dorsal with the ventral wall of the rectovaginal pouch is constantly in progress. In the male infants the average distance of the prostate covered with peritoneum at the intrauterine ages from 6.5 to 7.8 months was 71 per cent of the total length of the prostate while in male infants ranging from 8 months to full term only 33 per cent of the total length of the prostate was covered with peritoneum. This means that during the last month of pregnancy the rectovesical pouch receded far over half the distance of the pros-

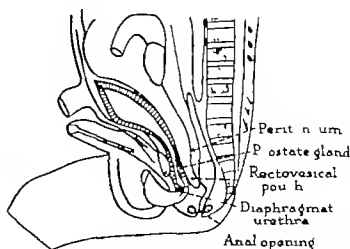


Fig. 12. Diagrammatic mid-sagittal section through pelvis of a male infant (4790, 1043) of 7.5 months' intrauterine age. The bottom of the rectovesical pouch extended caudally 2 millimeters below the apex of the prostate gland. The entire dorsal surface of prostate gland was covered by peritoneum.

tate gland which it covered during the preceding 1½ months.

In the female this process of retraction is not so pronounced. In infants ranging from 6 to 7.8 months intrauterine age the cranial 32 per cent of the vagina is covered with peritoneum while in infants ranging from 8.1 months to full term the part of the dorsal vaginal wall covered by peritoneum amounted to 29 per cent of the total length of the vagina. For some unknown reason the progress of retraction in the female is retarded at an earlier age than in the male infant resulting in the well known fact that in adult females the bot-

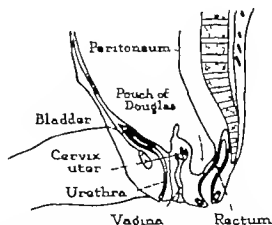


Fig. 13. Diagrammatic mid-sagittal section through pelvis of a female infant (4790, 1043) of 8.1 months' intrauterine age. The bottom of the rectovaginal pouch lies far below the level of the external orifice of cervix. 39 per cent of the total length of the vagina is covered with peritoneum.

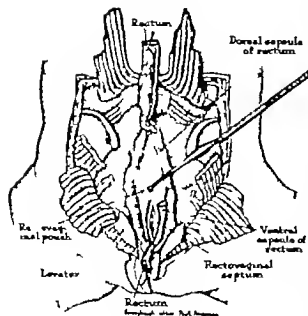


Fig. 4 Dorsal dissection of negro female infant (479, 1943) born term. The fascial capsules of the rectum and vagina, and the rectovaginal septum are shown as independent structures. The dorsal capsule of rectum was slit open longitudinally and reflected. The rectum was cut through transversely and its stumps reflected. The ventral capsule of rectum was slit open and retracted laterally; on the left side it was left (attached to the bottom of the rectovaginal pouch, on the right side its cranial end) as separated from peritoneum of rectovaginal pouch and reflected caudally. The rectovaginal septum is seen in the space between retracted parts of ventral capsule of rectum. In the slit of the incised septum is seen the dorsal capsule of vagina and through a slit in it the muscle layer of the dorsal wall of the vagina.

tom of the pouch in general lies closer to the pelvic floor than in adult males.

In the female infant (among other infants) illustrated in Figure 10 the rectovaginal septum was carefully examined and dissected in its median portion. For a distance of 27 millimeters of its longitudinal extent it could be clearly displayed. Its cranial end was firmly attached to the bottom of the rectovaginal pouch into the peritoneum of which it continued without any perceptible boundaries. The most caudal portion of the septum (beyond the extent of 27 mm) could not be clearly displayed; it seemed to broaden out (in dorsoventral direction) due to the inclusion of fibrous tissue both ventrally and dorsally. Some of the fibers seemed to be muscle fibers. The septum was anchored by this thickened portion into the pelvic floor just cranial to the

sphincter and externus. By gentle pressure, with a flat and blunt instrument, against the bottom of the rectovaginal pouch, the septum could easily be separated into a dorsal and a ventral leaf corresponding to the fused walls of the pouch.

One feature which is most conspicuous in the adult could be clearly demonstrated already in these early stages. In both sexes there is only some loose cellular tissue located in the space between the rectum and the rectovaginal septum. Ventrally on the contrary the septum is closely adherent to the prostate gland in the male infants and to the dorsal wall of the vagina in the female infants.

In Figure 14 a dorsal dissection of the pelvis of a female infant (479, 1943) is illustrated. The sacrum had been removed; the dorsal fascial capsule of the rectum was split open longitudinally and reflected; the rectum was cut through and its stumps reflected. The ventral capsule of the rectum was carefully incised longitudinally and retracted to either side. The rectovaginal septum was slit open and the capsule on the dorsal wall of the vagina was exposed through the slit of the retracted sides of the septum. The vaginal capsule was then incised and the muscle layer of the dorsal vaginal wall came into view. Throughout the dissection it was quite easy to differentiate between the peritoneum and the fascial components. But it was impossible to distinguish the rectovaginal septum from the peritoneum of the rectovaginal pouch. There was no boundary between the two structures; the transition of the peritoneum of the dorsal wall of the pouch into the septum was imperceptible. By palpation with the fingers, guided by previous experiences, the approximate extent of the pouch was ascertained and an incision was made about 1 centimeter above the level at which the pouch was believed to end. A blunt probe was then inserted through the opening and the caudal boundaries of the pouch were determined as shown in Figure 14. All these observations were checked and verified by further dissection after the drawing had been made.

As in the specimen illustrated in Figure 7 an attempt was made to reopen the fused

TABLE IV.—DEPTH OF POUCH OF DOUGLAS IN FEMALE INFANTS (in mm.)

Series 4791-50, 1943

(For method of measuring see Fig. 9)

Number	Pregnancy in months	Crown-rump length in cm.	I Bottom of pouch to anus (ventral commissure)	II Posterior fornix to bottom of pouch	
				a.	b.
				In mm.	In per cent of total length of vagina
5	6	30	80	4	9
	6 1/2		110.0	0	41
8			14	6	40
6	6 7/8 (30 wks.)			6	4
33	7	4 1/2	30		17
9	7.0	2 1/4	36	6	
8	7.4	5	36	5	35
23	7.8	7	24	14	34
28	8.1	8	1.0	7.0	30
32	8 1/2	8 1/2	34	7.0	8
	8 1/2	8 1/2	5 1/2	11.0	38
7	9		43	1.3	8
17	9		23	24	31
20	9.0		23	11.0	14
30	9		35	5	34
4	9		36	9	30

*Measure taken from dorsal opening into the pelvic cavity (see special records).

part of the pouch by cautious pressure exerted upon the bottom of the pouch the line of fusion was easily opened and the septum split into its ventral and dorsal leaves.

Another important observation was made in this specimen. The dorsal capsule of the rectum could be displayed easily along the entire length of the gut. The ventral capsule on the contrary became fused to the dorsal wall of the pouch and could not be displayed farther cranially as a layer independent of the peritoneum. As stated previously the same situation exists in many adult subjects.

SUMMARY

1 In the subperitoneal space which separates the rectum from the urogenital organs a transverse membranous septum the rectovesical septum in the male the rectovaginal septum in the female, is present which is attached cranially to the peritoneum at the bottom of the rectogenital pouch and caudally

to the dorsal surface of the prostate in the male to the dorsal surface of the vagina in the female. In some cases it may extend as far caudal as the pelvic floor.

2 Two views concerning the nature of this septum are in existence. According to one of them the septum is the result of a fusion in earlier intrauterine life of the dorsal with the ventral wall of the rectogenital pouch which originally extends as far caudal as the pelvic floor. According to the other view the septum is not of peritoneal origin but is purely of fascial origin. There is a third group of investigators who have not been able to demonstrate this septum in the female but claim that the tissue between rectum and vagina consists merely of the fascial capsules of these two organs and some loose areolar tissue in between them.

A. Observations in adults. 1 With few exceptions the rectogenital septum can be clearly demonstrated in the adult pelvis of

both men and women either in midsagittal sections through the pelvis or in dissections of the pelvis from the dorsal side. While there are subjects in which the septum is missing and others in which it is perforated or consists only of separate strips, it represents most often a firm transverse membranous partition between rectum and urogenital organs, attached cranially to the peritoneum of the pouch caudally to the urogenital organs.

2 In most instances the septum can be demonstrated as an individual structure additional to and independent of the fascial capsules of the adjacent viscera.

3 There is, however a constant difference in the relation of the septum to the capsules of the rectum and urogenital organs. From the capsule of the rectum the septum is separated by ample yet easily broken down loose areolar tissue but adheres closely to the capsules of bladder seminal vesicles, and prostate in the male and to the capsule of the vagina in the female. In creating perineal access to the space between rectum and urogenital organs the septum invariably comes to lie ventral to the finger separating the finger from the prostate or vagina.

4 When seen from outside or in sagittal sections, the rectogenital septum is continued without any visible boundary into the peritoneum of the rectogenital pouch.

5 Its surface texture is entirely different from that of adjacent fascial membranes. While the latter present a dull, whitish and felt like surface, the surface of the septum is glistening evenly membranous, of firm texture and sometimes of faintly greenish color.

6 The peritoneum of the pouch, when inspected on its inner surface, presents along the line along which the septum is attached to its outside, features which make this line most conspicuous as compared to the smooth, even surface of the remainder of the peritoneum of the pouch.

The attachment of the septum is marked by a simple whitish line which resembles a scar and may be slightly grooved. In some cases slight wrinkles running perpendicular to this line, may be seen in the peritoneum on either side of the line. In extreme cases the peritoneum is thrown into marked folds per-

pendicular to the line and strong peritoneal cords are developed bridging across the line, evidently as safeguards against splitting the septum and reopening the fused part of the pouch. The obvious interpretation of these features is that the white, scar-like line on the inner surface of the peritoneum of the pouch is the line along which the dorsal and ventral wall of the pouch have fused with one another and that in some cases special structures, such as the peritoneal cords, have developed to prevent a reopening of the closed portion of the pouch.

7 In accordance with these views is the fact, that application of cautious pressure along the white line will easily split the septum into its original dorsal and ventral leaves.

B Observations in infants 1 With exception of a single female full term infant in which the rectovaginal pouch still extended down to the pelvic floor in 36 male and female infants, varying from 6 months intramutuum to full term the rectogenital pouch of the peritoneal cavity had already started to retract from out of the rectogenital space and the rectogenital septum was developed.

2 As in adults, the rectogenital septum of infants is clearly differentiated as an individual membranous structure, independent of the fascial capsules of the adjacent pelvic viscera.

3 Relative to the prostate in the male and to the vagina in the female however the rectogenital pouch in the infant descends to a more caudal level than it does in adults therefore larger portions of both prostate and vagina are covered by the peritoneum of ventral wall of pouch in infants than in adults.

4 The extent to which the prostate and vagina are covered by peritoneum diminishes distinctly during the last months of intra uterine life, indicating that further retraction of the pouch is in progress during this period.

5 As in adults the tissue of the rectogenital septum is continued without perceptible boundary into the peritoneum of the rectogenital pouch. When viewed from outside it cannot be distinguished from the peritoneum of the pouch but is well differentiated from adjacent fascial tissues.

6 Applying slight pressure to the bottom of the rectogenital pouch, one succeeds easily

in splitting the septum into a dorsal and ventral leaf, corresponding to the dorsal and ventral walls of the pouch, through fusion of which with one another the septum has formed during earlier stages of development

CONCLUSIONS

Considering all the evidence presented in this article the authors conclude that the rectogenital septum as shown for the first time by Cunéo and Veau is of peritoneal origin and the result of a fusion of the dor-

sal with the ventral wall of the rectogenital pouch

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THE EFFECT OF SURGICAL INTERRUPTION OF THE GASTRIC BLOOD FLOW UPON GASTRIC SECRETION AND THE PREVENTION OF EXPERIMENTAL PEPTIC ULCERS

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CONSIDERATION of energy metabolism of the secreting parietal gland has shown that active secretion utilizes oxygen and glucose that the secretory pressure attains heights greater than the blood pressure indicating that the secretion is not simply an ultra filtrate of plasma, that augmentation of vascularity occurs concomitantly with secretion. It has been known for some time that an increase in vascularity is a prerequisite for glandular secretion (11).

Gray has computed the energy requirement for 1,000 cubic centimeters of active gastric parietal cell secretion to be about 1.5 calories which could be furnished by the oxidation of 5 grams of glucose. If 25 milligrams of glucose were removed from every 100 cubic centimeters of blood 168 cubic centimeters of blood per minute would have to circulate through the stomach to sustain a parietal secretion of 1,000 cubic centimeters per hour. Richards and coworkers have demonstrated a marked increase in the vascularity of the stomach during active secretion; others have found an increase of 30 to 40 per cent in cardiac output during active digestion. The energy requirements for active gastric secretion are satisfied by additional gastric blood flow.

Somervell employed ligation of gastric vessels as a mode of therapy in patients with peptic ulcer. He demonstrated reduction in free hydrochloric acid output following these ligations. The experiments of Layne and Bergh on dogs seemingly invalidate these clinical claims. Their animals did not survive ligation of all the major gastric vessels and ligations of lesser magnitude effected no change

in the acidity of histamine stimulated gastric juice.

Hay and associates have shown that injection of histamine in beeswax is productive of typical peptic ulcers in laboratory animals. Lannin has used histamine in beeswax to test the value of various types of gastrectomies in dogs. The failure to develop peptic ulcers after histamine in beeswax injections would critically test the value of gastric artery ligation as a form of therapy for peptic ulcer. As yet there has been no adequate experimental confirmation to indicate that the utilization of the ligation procedure would produce worthwhile results.

EXPERIMENTAL

The major gastric arteries of dogs were ligated under general anesthesia. The left and right gastropiploic arteries and vasa brevia were ligated and divided. The right gastric vessel is small and inconstant in the dog but when it could be identified it was likewise ligated.

The surviving dogs were kept for periods of 1½ to 3 months and then given daily intramuscular injections of 30 milligrams of histamine in beeswax. The dogs were sacrificed on the 15th day. Normal dogs were used as control animals for the histamine in beeswax injections.

The gastric secretory responses were studied with regard to volume and acidity in 4 dogs surviving 1½ months or longer.

RESULTS

Thirty dogs were subjected to gastric ligations. Of this group 16 died before injections of histamine and beeswax were started. In these 16 dogs the stomach showed a diffuse area

From the Department of Surgery, New York University College of Medicine, done on grant from the U.S. Public Health Service, National Institute of Health.

TABLE I—GASTRIC SECRETORY STUDIES ON FOUR DOGS SURVIVING GASTRIC VESSEL LIGATION

Dog N	Before ligation								After ligation							
	Fasting				Post histamine				Fasting				Post histamine			
	pH	Free acid	Total acid	Volume in c.c.	pH	Free acid	Total acid	Volume in c.c.	pH	Free acid	Total acid	Volume in c.c.	pH	Free acid	Total acid	Volume in c.c.
349	7.0		QNS		1.7	0.2	0.0	8.5	7.0		QNS		8.1	7.1	8.1	5.1
16	7.0		QNS		1.1	0.1	1	5.1	7.0		QNS		1.1	0.1	0.1	5.1
440	7.0		QNS				0	30	7.0		QNS			7		40
LE	7.0		QNS		0	70	77	7	7.0		QNS		1.1	0.1	0.1	7.1

Approximate values as determined by test papers

On occasion (not included in the average) no free acid was obtained and pH was in the region of 4

On occasion (not included in the average) no juice as obtained and stomach washings with distilled water contained no free acid

of infection in 4. In 4 others perforated ulcers were seen on the greater curvature adjacent to the spleen. In 2 dogs a nonperforated gastric ulcer was seen adjacent to the spleen on the greater curvature of the stomach. In 6 dogs the stomach was normal, death being due to other causes.

Fourteen dogs survived a period of 1½ to 3 months; these dogs were injected intramuscularly with 30 milligrams of histamine in beeswax daily for a period of 14 days and sacrificed on the 15th day. Four of these dogs died before completion of the injections. Of these 2 had large perforated ulcers high on the greater curvature adjacent to the spleen. One dog died of other causes but was found to have a chronic penetrating ulcer in a similar position. The ulcers were similar in appearance, position, and shape to those seen in dogs in which ulcers had developed following vascular ligation alone. One dog had occasional very shallow pinhead sized erosions in the prepyloric area. The remaining 10 dogs were sacrificed on the 15th day and were subjected to postmortem examinations. Of these dogs one showed occasional pinhead sized superficial erosions in the antrum. The 9 other dogs showed no evidence of ulceration upon examination.

Ten normal control dogs were given daily intramuscular injections of 30 milligrams of histamine in beeswax and were sacrificed on the 15th day. Four dogs had typical duodenal peptic ulcers and 1 dog had a typical prepyloric peptic ulcer on the lesser curvature. Of the remaining 5 dogs 2 showed small duodenal erosions and 2 showed hemorrhagic

duodenitis or gastritis. Although only half of the dogs developed typical peptic ulcers, in none was the stomach or duodenum found to be normal.

In 4 dogs the secretory responses to aqueous histamine (1 mgm.) were studied in the fasting state before and after ligation. This was accomplished by passing a tube through the mouth into the stomach. The stomach was emptied of its contents by aspiration immediately before the administration of histamine and 1 hour later. The pH of the aspirated contents was obtained by means of a glass electrode. The free and total acids were determined with Topfer's reagent and phenolphthalein. If the fasting contents contained free acid the test was discontinued and repeated on another day. The average of the 3 most optimum responses of 6 or more tests are tabulated in Table I. As a rule gastric ligation did not affect the values for pH and free and total acid in the optimum responses but the volume of secretion was markedly reduced. The results are in accord with those of Layne and Bergh who did not, however, study secretory volume changes. Following ligation the secretion was so scant that, on many occasions, it was often necessary to wash out the stomach with distilled water in order to determine the presence of free acid. Often histamine failed to evoke a secretory response after ligation or the juice was low in free acid and of relatively low hydrogen ion concentration (pH).

The response to insulin was likewise tested and was found to be such a weak stimulus that consistent results were not obtained prior to

ligation. As a rule the free acid rarely rose above 50 units before ligation and little response was obtained with a comparable dose after ligation.

MICROSCOPIC EXAMINATION OF ULCERS PRODUCED

Those ulcers which appeared in the control dogs (without vascular ligations) were typical peptic ulcers, the description of which is so well known that only brief mention will be made of the changes for purposes of contrast. These ulcers all had sharply demarcated margins with overhanging edges of viable mucosa. As a rule the following zones could be made out in the ulcer: a zone of necrosis, a zone of fresh granulation infiltrated with inflammatory cells, and a zone of fibroplasia (beginning scar tissue formation) at the base. The viability of the mucosa adjacent to the ulcer was unimpaired.

All the ulcers appearing in those dogs which had ligations of their gastric vessels differed from the true peptic ulcers described. Mucosal coagulation necrosis (or the earlier cellular changes of this process) adjacent to the area of ulceration was always found. In those dogs dying with infarction the necrosis was more widespread but still more pronounced in the mucosa. The inflammatory reaction and the zone of viable granulation tissue were much less prominent in this group of ulcers and frequently absent. The microscopic findings for the reasons enumerated failed to illustrate a punched out area of ulceration but rather presented an area of superficial necrosis which became deeper as the center of the ulcer was reached.

Briefly, the true peptic ulcers show lytic necrosis produced by digestion of living tissue. The ulcers of vessel ligation show coagulation necrosis with secondary digestion and the tissue response which is dependent upon blood supply is less pronounced.

DISCUSSION

Cutting and associates studied the volume and acidity of gastric secretion in cats together with simultaneous volumetric measurements of venous return from the stomach. They found the volume of acid secretion after histamine

stimulation, to be directly proportional to the rate of blood flow. When the rate of gastric blood flow after histamine stimulation was altered by physical means or vasomotor drugs, a corresponding change occurred in the secretory volume. They conclusively proved that with an augmented rate of secretion as increased blood flow occurs and that any factor which prevents this increase in blood flow will likewise restrict the secretory response. All our experimental findings are in complete accord with the findings of Cutting and his co-workers.

Whether the ligation of vessels would be a practical method of reducing gastric secretion and whether this reduction would be sufficient to prevent or cure peptic ulcers is a matter of conjecture.

That the human stomach can be almost completely deprived of its blood supply and yet remain viable has been adequately demonstrated in the operative attack on carcinoma of the esophagus. In this procedure the stomach is drawn into the chest cavity and anastomosed to the distal cut end of the esophagus. The failure to develop vascular ulcers and infarctions in most of the dogs operated upon further illustrates the extent to which the stomach may be deprived of its vascular supply. Other reports (8) to the contrary, notwithstanding. It became apparent early in the course of the experiment that if the stomach were not handled with extreme gentleness ulcer or infarction would occur. In the last 12 dogs on which ligations were performed, no not only did infarction or perforated gastric ulcers develop.

It may well be that those dogs operated upon in the histamine treated group which had gastric ulcers had them prior to the injection of histamine in beeswax. Microscopically the maturity and the density of fibrosis tended to confirm this impression. Also the ulcers developing from ligation alone were high on the greater curvature adjacent to the spleen. The ulcers which developed after histamine in the ligated group were in an identical position and similar in type. The microscopic pathology previously discussed was characteristic of vascular ulcers and unlike true peptic ulcer. One must therefore conclude that the ulcers devel-

oping in the ligated group were on a vascular basis. In sharp contrast ulcers developing in the histamine treated controls were typical duodenal and prepyloric peptic ulcers. Ligation of the major gastric vessels had protected against the development of "typical" peptic ulcers, and in addition, had protected against associated ulcer pathology such as hemorrhagic gastritis or duodenitis and duodenal erosions.

It is possible that the beneficial effects of vagotomy may be produced by a reduction in blood flow caused by section of the vasodilator nerve fibers to the blood vessels of the stomach. Section of the vasoconstrictor or sympathetic nerve fibers to the stomach is frequently productive of typical peptic ulcers (1). A concept of the secretory mechanism as proposed by Mathews, was that the production of secretion was effected by an increase in blood flow. The autonomic nerves serve as regulators of the blood flow. Such a concept is an oversimplification since it disregards the qualitative changes in secretion resulting from either sympathetic or parasympathetic stimulation. Nevertheless it seems that the alteration in blood flow which is produced by such nervous stimulation is the factor of major importance. More recently, Wolf has shown that a striking decrease in gastric blood flow takes place after the performance of vagotomy in humans.

That protection by ligation occurs without alteration in the pH of the optimum histamine response may seem incongruous. An all or none law for parietal cell secretion has been adequately proved (1). The parietal cell either secretes hydrochloric acid at a fixed acidity or does not secrete at all. Alterations in pH and free and combined acid result from partial neutralization of this hydrochloric acid by other alkaline components of secretion (5, 10). Histamine stimulates almost exclusively the acid components of secretion. Since the pH of histamine stimulated juice is unchanged by vascular interruption those cells which are able to secrete do so in the all or none fashion at a fixed pH.

However a reduction in blood flow does not make allowance for the satisfaction of the energy requirements of rapid secretion and the

volume of free acid secretion is reduced. This reduction in the total amount of free acid is sufficient to protect against ulceration; the duodenum is able to neutralize small quantities of hydrochloric acid effectively. The importance of the volume of acid pepsin in the production of ulcers has been established in a previous publication (9). It is of importance to point out that although optimum responses were unchanged qualitatively in the ligated group the dogs (except No. 440 in Table I) did not respond in more than half of the instances to histamine stimulation and remained achlorhydric or had scant secretion of low acidity. Since these same dogs responded well prior to ligation, one must assume that the ligation was the factor which was responsible for the lack of response.

A reduced gastric blood flow might effectively lower the hydrogen ion concentration of the total gastric secretion by decreasing the acid component when the stimulus involves both acid and alkaline components (as in vagus stimulation). The fact that insulin stimulation (post ligation) did not markedly alter the pH of the stomach contents may be explainable on this basis.

Postmortem examination of dogs as long as 4 months after ligation of the gastric vessels did not reveal a collateral circulation comparable to the initial circulation. It is therefore reasonable to make the assumption that the effects of such extensive ligations would be permanent.

Peptic ulcer of the esophagus is most often associated with ectopic gastric mucosa and peptic ulcers are not infrequently found in the stomachs of paraesophageal hernias. Even so peptic ulcers do not form in the esophagus after the operation which has been described by Phemister for removal of carcinoma of the esophagus. This fact may be attributable to the reduction of blood flow in the stomach transplanted to the intrathoracic position. Such clinical observation would tend to support the efficacy of gastric ligation as a form of therapy for peptic ulcer.

SUMMARY AND CONCLUSIONS

Ligation of the major gastric vessels by disturbing the energy requirements for secre-

tion can effectively reduce the amount of hydrochloric acid secreted by the stomach. This reduction in acid formation is sufficient to protect dogs from development of typical peptic ulcers induced by the intramuscular injections of histamine in beeswax. With extensive ligations however there is danger from the production of vascular ulcers on the midportion of the greater curvature of the stomach. Investigative work is now being carried out to determine the extent of ligation necessary for protection which might be free from hazard of vascular ulcers. There is a possibility that the beneficial effects of vagotomy might be attributable to a reduction in gastric blood flow.

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THE REPAIR OF HERNIA

With Special Application of the Principles Evolved by
Bassini, McArthur and McVay

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SINCE man first discovered the nature of groin herniation and conceived the idea of surgical repair the archives have become replete with procedures and variations each designed to ameliorate the problem of correcting the anatomic defects and consequent mechanical failure of the supporting structures in that area of the body.

In the selection of a satisfactory herniorrhaphy one must consider certain anatomical, physiological and mechanical principles that will withstand the scrutiny of statistical studies as pertains to the end results. These principles, substantiated by experimental observation, seem to be embodied in a combination of the Bassini, the McArthur and the McVay procedures for the repair of hernia. It has seemed to the authors that this can be accomplished by utilizing the locally available aponeurosis of the external oblique as strips of suture material (McArthur) to unite the inguinal structures to Cooper's ligament (McVay) and by reinforcing the floor of the canal (Bassini) as the surgical conjoined tendon is sutured to Poupart's ligament.

THE BASSINI CONTRIBUTION TO HERNIA REPAIR

Eduard Bassini described and illustrated his method of repairing inguinal hernia as he devised it shortly prior to 1890.

The principle of his operation is to reinforce an anatomical defect by decreasing the size of the internal ring and reinforcing the floor of the inguinal ligament. This he did by suturing the three layers, namely, the internal oblique muscle, the transversus abdominis muscle and the vertical fascia of Cooper (transversalis fascia) to Poupart's ligament. He then replaced the cord and sutured the fascia of the

external oblique over, re-establishing the inguinal canal and the external ring in its normal anatomical position.

Since then many other operations have been designed to narrow the opening at the internal ring and to reinforce the floor of the inguinal canal.

MCARTHUR'S CONTRIBUTION TO HERNIA REPAIR

In 1901 L. L. McArthur of Chicago reported the use of strips of the tendinous portion of the external oblique as suture material in performing the Bassini and other popular herniorrhaphies of that time. His technique consisted essentially of splitting the external ring upward and parallel to the fibers of the external oblique as far as the muscle insertion (5 to 6 inches). The edges of the aponeurosis were then raised and a strip of fascia $\frac{1}{8}$ to $\frac{1}{4}$ inch wide was split loose from the internal flap, cut free at the upper lateral end and left attached at the lower end where the internal pillar of the external ring attaches to the pubic tubercle. If a Bassini type of repair was used, he cut a similar strip from the outer lower flap of the external oblique aponeurosis, ending in the external pillar. These strips were threaded onto a needle and secured with a tie of silk to serve as a continuous stitch. He anchored the end of this stitch by a simple knot or a through and back stitch such as a tailor uses to fix his thread. The cord was placed according to the type of procedure chosen.

McArthur determined the tensile strength of these strips to be between 11 and 24 pounds. He supported his work by dog experimentation in which he showed that the fascia healed *in situ* was not absorbed and did not slough. In his final report in 1904 he cited 93 cases without recurrence and 1 example of excised tissue from a man 1 year postoperative showing the fascia strip to be still present.

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If McArthur had lived in this generation he would have in all probability applied the use of these fascial strips to a McVay type of repair much as we have done it in accordance with the description outlined in this paper. He suggested that these fascial strips could be used in any type of hernia technique.

The principle of autogenous fascial suture was studied in 1909 by Kirschner. It remained for Gallie and LeMesurier in 1924 to complete the experimental and clinical studies and to establish fascial and aponeurotic suture as a sound, useful and generally acceptable surgical tool. They demonstrated that a transplant showed the phenomenon of inflammation for a period of 3 weeks but that no absorption, invasion or infiltration occurred and that at the end of 1 year the fascia or aponeurosis had exhibited no histologic change. They concluded that healing between fascial strips and the surrounding tissue occurred by scar formation, that avoidance of intervening areolar tissue and establishment of broad contact surfaces was an aid but that reliance was placed more upon the suture itself than upon the scar. Gallie and LeMesurier repeatedly demonstrated that their transplanted strips of woven fascia lata had in no instance stretched, contracted, or ruptured.

A transplanted patch of fascia lata was used by Singleton and Stehouwer in the repair of severe direct and ventral hernias. At reoperation of 6 patients they found no reabsorption of the patch. In situations where broad contact between patch and local tissue was impractical they too preferred fascia strips since strips did not depend upon scar tissue to maintain the repair. Haas believed that transplanted fascia lata actively participated in a strong union with the muscle to which it was sutured.

In seeking to obviate the necessity of a second operative site as in the Gallie procedure Koonts made use of preserved fascia in hernial repair. He found as did Nageotte in the case of dead tendon grafts that the preserved fascia became living by a process of repopulation by fibroblasts from the host.

Pedicled grafts of the iliotibial tract of the fascia lata have been employed by Wangensteen for repair of large inguino-femoral and

abdominal wall defects. More recently Wangensteen has shifted a patch of fascia from the lower abdomen to cover a defect in the upper abdomen and has then used his pedicle fascia lata graft to cover the dispossessed area in the lower portion of the abdomen. Burton and Ramos made use of the femoral canal through which to conduct a similar pedicle. Mattice devised the use of a flap of rectus sheath to accomplish a Cooper's ligament type of herniorrhaphy.

Neuhof cited 6 to 12 months follow-up studies of experimental fascial transplants and believed that even autogenous fascial transplants became replaced by a fibrous structure of a nature similar to the original.

In a study of comparative strengths Horley found fresh autogenous fascia lata to be superior to dead preserved fascial transplants. Studies which have been made by the aforementioned authors clearly indicate that fascial strips have been widely used particularly when the defect is so large that the ordinary means of repair seem impractical. When these facts are taken into consideration one can reasonably conclude as Payne points out, that fascial suture of the McArthur type should be a very satisfactory suture material to be used in a standard herniorrhaphy.

Burdick and Gillespie summarized the end results of 1,485 cases in which hernias had been repaired by various types of fascial suture. They felt discouraged with the high incidence of recurrence and infection which was observed with fascial sutures. They made no comparison with groups of hernias of equal severity wherein foreign material was used. Since the highest percentage of the more difficult repairs in their series fell into the fascia group it seems not justifiable to lay the blame of recurrence on the fascial suture.

Guthrie Olson and Masson analyzed the results in 2,208 patients and found a recurrence rate of 7.8 per cent with autogenous fascia as against 5.6 per cent for foreign suture material. They found that fascia was used much more frequently in severe and recurrent hernias, obese individuals, those with poor musculofascial development and in men. They felt that by giving reasonable weight to these disadvantages the small statistical difference

could be more than discounted and favor placed with fascial suture

Gallie believes that failure in many cases of fascial suture repair is due to failure to anchor adequately the end of the strips. A proper tie at the end or a wire retaining suture will prevent slipping

Burdick and Gillespie feel that the passage of a large needle through Poupart's ligament will cause tearing. Cooper's ligament is sufficiently tough to withstand the strain

THE McVAY CONTRIBUTION TO HERNIA REPAIR

The use of Cooper's (superior pubic) ligament as an anchor for the inguinal strata has become accepted as a sound surgical procedure since McVay and Anson published their anatomic investigations and suggestions for the surgical application to the repair of inguinal hernia.

Cooper first observed this structure in 1804 and some years later suggested its use in the repair of hernia. Mattson in reviewing the literature pertinent to Cooper's ligament stated that Lotheisen in 1898 and Narath before him had made use of the superior pubic ligament to repair femoral and inguinal hernias. By 1927 Babcock was using the medial part of Cooper's ligament, near the pubic tubercle as a part of the procedure in inguinal repair

Before Cooper's ligament came into general use for inguinal herniorrhaphy Moschcowitz in 1907, Seelig and Tuholske in 1914 and Dickson in 1936 described its use in femoral hernia.

From dissections of over 300 inguinal regions McVay and Anson noted that the inguinal ligament was not the normal insertion for the inguinal portion of the transversalis fascia transversus abdominis and internal oblique which are actually inserted on Cooper's ligament and the pubic pecten. They maintain that the relationship of these structures to Poupart's ligament is only one of continuity

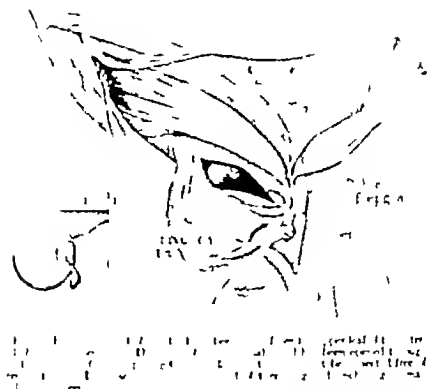
McVay also stated that the conjoined tendon is an artefact of dissection and that the true falx or ligament of Henle is a lateral expansion of the rectus abdominis tendon of insertion on the pubic pecten. Rlenhoff like-

wise found no conjoined tendon as had been previously described. McVay and Anson also observed that the inguinal ligament is only loosely held in its convex position by surrounding fascia and is easily shelled out to become the free margin of the aponeurosis of the external oblique. They demonstrated that when the inguinal strata are sutured to Poupart's ligament a cephalad bending easily occurs which leaves the inguinal region exposed below it. It is their opinion that recurrent hernia masses appear in the stretched weakened area below the elevated inguinal ligament. It is for these reasons that McVay ignores the inguinal ligament in the procedure of his herniorrhaphy. He sutures with nonabsorbable material the inferior margin of the transversus abdominis aponeurosis and its attached transversalis fascia to Cooper's ligament starting at the pubic tubercle and extending along Cooper's ligament to the femoral vein. He states that when the internal oblique muscle is aponeurotic in nature its lower border is also included in the suture.

This bulk of tissue was designated by Bassini as the *dreihaupt*; it has been erroneously called the conjoined tendon and is commonly referred to as the surgical conjoined tendon (Fig. 1).

From observations regarding mechanical forces applied to the inguinal area Lick and Samson concluded that a hernioplasty which employs Poupart's ligament creates an abnormal trihedral upon which intra-abdominal pressure exerts a force against the hernioplasty wall about sixty-two times that exerted against the normal oblate ellipsoidal floor. They felt that the use of Cooper's instead of Poupart's ligament was of great importance because then the normal ellipsoidal contour of the inguinal region was preserved. They also noted that the maximum pressure is only a few millimeters caudad to the deep epigastric vessels at the exact point of appearance of direct inguinal hernia.

A McVay type of repair seems the best mechanical support to this area providing a barrier against an approach to the floor of the inguinal canal through which direct hernias must protrude in order that they may become evident.



Harkin and Swenson reviewed the experience with 322 hernia repairs by the McVay type procedure via a semicircular incision at the late twelfth century. They had only one recurrence. Many other surgeons have discarded the H type procedures in favor of the McVay principle.

HERNIA REPAIR SHOWS THE FOLLOWING PRINCIPLES

It has impressed us that each of these principles of hernia repair has some advantages. A procedure has been devised incorporating these principles into the repair of inguinal and femoral hernia.

General anesthesia is employed. Curare is used to obtain relaxation.

The usual skin incision is made by a slight increase in length and a downward curve in its medial one third. These variations in the skin incision give a more roomy exposure to the muscular origin of the aponeurosis of the external oblique and the insertion of the fascia in the region of the pubic tubercle and Cooper's ligament.

A triangular area of external oblique aponeurosis is dissected free of its areolar tissue. A suture is inserted into the external ring, at the level of its upper margin. The fascia is split from the point laterally to the muscle fibers. This leaves a relatively broad lateral leaf of external oblique fascia which can be dissected from the roof of the inguinal canal and tunnel back (Fig. 1).

The medial (upper) leaf of this fascia is dissected free from the underlying internal oblique muscle for about 3 centimeters so as to expose the internal oblique muscle and the upper conjoint tendon.

The hernial sac is dissected free, it is ligated and is sclerotized.

Three $\frac{1}{4}$ inch strips are then made from the upper leaf of this fascia, precautions being taken to see that the strips do not extend obliquely across the fibers lest tearing develop. The preparation of these strips of fascia constitutes McArthur's contribution to the repair of hernia.

One of these strips is detached from the pubic tubercle end and two from the muscular

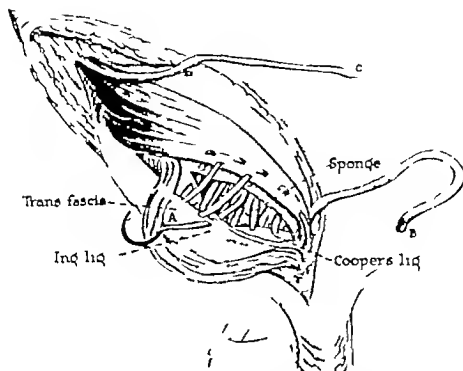


Fig 2 Fascial suture 1 has been partially completed. By following it from its point of attachment near the pubic tubercle it will be observed anchoring the surgical conjoint tendon to Cooper's ligament then passing across the floor of the inguinal canal, reapproximating the transversalis fascia and also approximating the edge of the internal oblique muscle to the inguinal ligament. A sponge holds back the preperitoneal fat while this suturing is being made and is removed at this stage of the operation before snugging up the tissues as illustrated in Figure 3.

end leaving them attached at their opposite ends (Fig 1 A B C)

In order to facilitate anchorage of the strip on a small oval calibered Gallie type needle the two lateral ends when cut free are left with a $\frac{3}{8}$ inch bud of muscle attached. The strip with a free medial end is cut transversely so that it contains some cross striations of the reflected portion of the rectus sheath. The fascia strip is inserted through the eye of a Gallie type needle. This strip is then pulled through the eye so that the needle point can be passed through the fibers of the strip about 3 or 4 millimeters from its free end (see insert Fig 1). The cross fibers in the muscle bud of the two free lateral ends (Fig 1 A B) and the cross fibers of the free medial end (Fig 1 C) serve to keep the fascia from stripping off the needle when tension is applied while suturing. This threading of the needle also permits use of the full length of the fascia strips.

Cooper's (superior pubic) ligament is now exposed by cutting through the thin transver-

salis fascia which lies under the cord forming the floor of the inguinal canal (see Fig 1). If the hernia is direct in character this has been already accomplished when the sac was dissected out. Usually the pubic branch of the inferior epigastric (or sometimes spermatic artery) passes transversely across the floor of the canal lying in the deeper structures of the transversalis fascia. This vessel (Fig 1) must be isolated and tied lest annoying bleeding confuse the further dissection.

Cooper's ligament lies underneath the transversalis fascia and can be easily palpated as a hard tendinous structure. It passes obliquely downward and laterally from the pubic tubercle. This strong tendinous ligament is exposed laterally nearly to the femoral vein. A dry 2 by 2 sponge is inserted into this depth to rid the field of preperitoneal fat for protection of the femoral vein and to dissect the loose areolar tissue away from Cooper's ligament. It is left there until the stitches through Cooper's ligament have been placed. It is re-

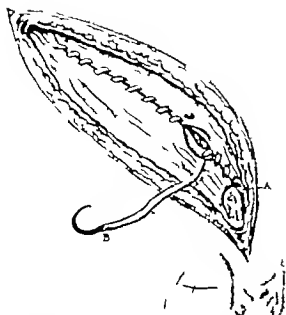


Fig. 4. Strip A now disappears from view. Strip C has been completed. Strip B has reformed a new external ring and is closing medial end of external oblique aponeurosis.



Fig. 5. All fascial strips have been completed. B and C overlap for about 2 inches. Each has been anchored with a wire suture of No. 32 stainless steel.

The internal ring is made smaller by passing the fascial strip close to its medial margin.

The tissues which have been included in this first stitch of fascia (Fig. 2 A) are approximated as the fascial strip is snugged up and the end of the fascia strip is anchored with one tie of No. 32 stainless steel wire (Fig. 3 A). It is then cut free from the needle. This portion of the procedure completes the first two stages—that of blocking the approach to the floor of the canal by suturing the bundle of muscles and transversalis fascia to Cooper's ligament (McVay) and of suturing the edge of the surgical conjoint tendon to the inguinal ligament thereby reinforcing the floor of the canal (Bassini).

The retracted cord is then replaced into the inguinal canal over its reinforced floor and the edges of the aponeurosis of the external oblique are sutured together over the cord with the second and third running stitch of fascia (Fig. 3 C and Fig. 4 B).

This changes slightly the position of the spermatic cord in that it assumes a slightly higher position as the lateral leaf of the external oblique fascia is pulled over to meet the remaining medial leaf. This also changes the position of the external ring so that instead of

finding the pubic tubercle at its medial margin it now is found at its medial and inferior margin.

Care is taken to stagger the bite of the stitch through the fascia and inguinal ligament in order to prevent splitting of the aponeurosis.

The strip of fascia with its attachment remaining at the muscular end is used to close the lateral rent in the fascia of the external oblique (Fig. 4 C). The second and third strips of fascia overlap one another for a distance of about 2 inches (Fig. 5). The end of each strip of fascia is anchored with a wire stitch. No other foreign suture material is used.

Curare is used to promote relaxation of the muscles in order to facilitate approximation without tension.

Bleeding is adequately controlled throughout the course of the operation. The skin is closed with clips.

All patients are fitted with a wide support ing abdominal girdle which they are required to wear for 6 months after the operation. This is done as a precautionary protection against the breaking of structures during the period in which scar tissue becomes well organized and firm.

SUMMARY AND CONCLUSIONS

The use of fascia as a suture material in a standard inguinal herniorrhaphy is a sound and practical procedure. Evidence as indicated in the literature suggests that fascia sutures possess strength in themselves as well as approximating values during the period of fibrous tissue proliferation. The McArthur type of strip has the additional value of being indigenous to the area of repair.

Supporting evidence has been presented from a review of the literature showing that the use of Cooper's ligament is anatomically and mechanically correct.

A procedure has been described which employs three generally accepted principles in the repair of hernia, namely: the use of locally available fascia for suture (McArthur) to approximate the inguinal strata to Cooper's ligament (McVay) and the reinforcement of the floor of the inguinal canal (Bassini).

Rather than reserve a stronger type of repair for the recurrent hernias it seems justifiable to employ the strongest type of repair on the first occasion, thereby eliminating the need for additional repair.

At the date of this writing we have repaired 40 hernias (inguinal and femoral) by this method without complications. There have been no failures though it is yet too early (6 months) to determine the eventual end results.

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REDUNDANT BLIND SEGMENTS OF INTESTINE FOLLOWING SIDE-TO-SIDE ANASTOMOSIS WITH DIVISION OF THE BOWEL

Report of 5 Cases

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AFTER the removal of a segment of bowel several methods of restoring continuity of the intestinal tract are available. Each method has many advocates and circumstances such as the anatomic characteristics of the particular segment of bowel involved or the presence of obstruction, may influence greatly the choice of method. The use of a side-to-side anastomosis after the inversion of the two cut ends is a standard safe method however the possibility of complications arising from the proximal end has long been recognized. These complications are almost invariably associated with excessive length of the proximal segment of the bowel distal to the anastomosis and they should be largely preventable by careful attention to the length of this segment. How frequently such complications develop cannot be estimated but in view of the wide spread knowledge of the hazards associated with a redundant segment we were amazed to find in the literature so few papers dealing with these complications.

Pearse using dogs showed that a blind loop of bowel distal to an anastomosis became a functionless segment of intestine if the direction of the peristalsis was away from the blind end and toward the anastomosis. However if peristalsis was toward the blind end material was carried into it and stagnated there. The occurrence of changes in the blind proximal loops depended on the length of the loops in those loops which were less than 2 feet (60 cm) in length no pathologic changes developed. Those loops 3 to 4 feet (90 to 120 cm.) in length became hugely dilated hypertrophied and filled with inspissated intestinal contents.

If perforation did not occur these long blind loops caused anorexia, lethargy, emaciation and finally death after 3 or 4 months. Excision of the blind loops if carried out in time was followed by complete recovery of the animals. Loops 5 to 6 feet (150 to 180 cm) in length represented such a large part of the total intestinal length that the majority of the animals died from inanition. Estes and Holm also using dogs confirmed the observations of Pearse that when peristalsis was toward the blind end of the bowel after division of the bowel and side-to-side anastomosis either between the ileum and colon or between segments of the small bowel the blind segments became dilated to three or four times their normal diameter. Ulcers developed frequently and subsequent perforation was not uncommon.

There are few reports of clinical cases in the literature. This may be explained in part by the fact that in the past the mortality rate associated with this type of surgery has been high particularly so in cases in which the technical aspects of the operation were not entirely satisfactory. A fact of greater importance however is that probably excessively long loops are not left usually and that shorter loops are not associated with symptoms of sufficient severity to warrant operation. Thus the statement is made by Rankin, Bagen and Bue that hypertrophy and elongation of blind loops of ileum have been observed at necropsy years after resection of the colon with side-to-side anastomosis between the colon and small bowel (Fig 1). Similarly, Pickhardt reported a case of resection of the right portion of the colon and terminal part of the ileum with side-to-side anastomosis between the transverse colon and ileum in which

From the Divisions of Surgery, Mayo Clinic and Mayo Foundation.

SUMMARY AND CONCLUSIONS

The use of fascia as a suture material in a standard inguinal herniorrhaphy is a sound and practical procedure. Evidence as indicated in the literature suggests that fascia sutures possess strength in themselves as well as approximating values during the period of fibrous tissue proliferation. The McArthur type of strip has the additional value of being indigenous to the area of repair.

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ileum. Nothing further was advised at that time since the sinus closed spontaneously. Two weeks later, however, fecal and purulent drainage again developed associated with marked constitutional symptoms and fever as high as 103 degrees F. Recovery from this attack was slow and after approximately 10 weeks surgical exploration of the anastomosis was carried out. The side-to-side anastomosis between the ileum and transverse colon was found to be functioning satisfactorily. There was a redundant blind segment of ileum distal to the anastomosis the lumen of which connected with the cotaneous opening. This loop of ileum had become hypertrophied and elongated. Ulceration had presumably occurred which had progressed to perforation. The operation was limited to excision of the redundant loop. The patient made an uneventful recovery and has remained well since.

CASE 2. A white man aged 48 years was seen in an emergency in July 1944. He had been awakened in the early morning by severe crampy abdominal pain which had gradually become worse. There was no accompanying vomiting but some nausea. One year previously repair of a left inguinal hernia had been carried out at the clinic. Ten days later mesenteric thrombosis had developed necessitating resection of approximately 28 centimeters of jejunum because of gangrene. Intestinal continuity had been re-established by means of side-to-side jejunojejunostomy.

On admission the patient's temperature was 100.4 degrees F., the pulse was 90 beats per minute and the blood pressure 120 millimeters of mercury systolic and 95 diastolic. The heart and lungs were normal. The abdomen was rigid and tender generally but tenderness in the right lower quadrant was most marked. Examination of the urine gave negative results. The leucocytes numbered 9,900 per cubic millimeter of blood. A scout film of the abdomen made without administration of barium revealed free gas in the peritoneal cavity.

Surgical exploration was carried out shortly after admission. The blind inverted end of the proximal segment of jejunum distal to the anastomosis was reddened, thickened and covered with fibrinous purulent exudate. The mesentery was thickened and edematous but there was no evidence of mesenteric thrombosis. When the region of the anastomosis was first approached about 30 cubic centimeters of thick pus was encountered. The blind end of the distal segment of the jejunum was 4 to 5 centimeters in length and showed no evidence of obstruction or inflammation. Both blind ends of bowel were excised and the ends reinverted so that no redundant segments were left. Pathologic examination of the proximal loop revealed inflammation with ulceration, abscess formation and perforation. The shorter distal loop revealed only mild inflammation.

Pneumonia developed postoperatively and in spite of treatment with penicillin and the sulfonamides the patient died 8 days after operation.

CASE 3. A white married woman aged 27 years first seen in August 1944 complained of intermittent

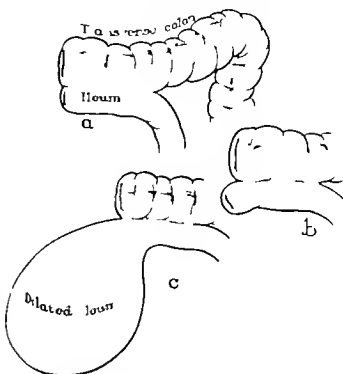


Fig. Side-to-side ileotransverse colostomy. a. Cor rect method, making united ends of bowel as short as possible. b. Slight dilation of proximal end of small bowel which normally occurs. c. Large dilated blind loop of small bowel which occurs when redundant loop is left too long.

attacks of crampy abdominal pain, vomiting, distention and constipation which had first developed after a partial resection of the small bowel 4 years before. The individual attacks often lasted as long as 4 days. In April 1940 the patient had undergone surgical exploration elsewhere and appendectomy, left salpingectomy, and suspension of the uterus had been carried out. In September 1940 65 centimeters of gangrenous ileum had been excised and a side-to-side anastomosis established between the segments of ileum.

Physical examination gave essentially negative results except for a ventral hernia which had developed in the scar of the former incision. There were no masses on pelvic examination. Leucocyte and erythrocyte counts were normal as was the urinalysis. Roentgenographic examination of the chest, stomach, gall bladder and colon was negative. Roentgenographic examination of the small bowel revealed a dilated blind loop of ileum near the former anastomosis which seemed adequate.

Surgical exploration of the abdomen was carried out in September 1944 and the previously established antiperistaltic side-to-side anastomosis between segments of the ileum was examined. The proximal blind end of ileum had become dilated and hypertrophied so that it exceeded the size of a normal stomach, being about 45 centimeters long and approximately 10 centimeter in diameter. Excision of the ileocecal stoma, including both blind ends of bowel, was carried out and intestinal continuity was

the blind loop of ileum became elongated and dilated without causing symptoms. He pointed out, however that the blind loop was a potential source of danger from the standpoint of obstruction.

We were able to find reports of a few cases, however in which serious symptoms were produced by redundant blind loops. Turner referred to a case in which a blind ileal segment, left after resection of the right portion of the colon with side-to-side anastomosis between the transverse colon and ileum ruptured when the patient fell downstairs. Eckel and Holman reported a case in which vague intermittent abdominal distress developed and persisted without change for 10 years after hemicolectomy on the right with side-to-side ileocolostomy. At subsequent operation a distended blind segment of ileum distal to the anastomosis was excised with complete cure of the patient. Sletten in a discussion of Pickhardt's paper mentioned a case in which such a blind loop perforated. Estes and Holm reported the case of a 16 year old boy in whom after resection of the terminal part of the ileum and establishment of a side-to-side anastomosis between the ascending colon and ileum, a short blind loop of ileum had been left distal to the anastomosis. A few months later intermittent pain, borborygmi and low abdominal distention developed. The blind segment had become hugely elongated, distended and ulcerated and filled almost a third of the abdomen. Resection of the blind loop resulted in complete relief of symptoms. Ginzburg, Colp and Sussman reported 3 cases in which blind loops of ileum gave rise to symptoms after side-to-side ileocolostomy with division of the bowel. In 2 of the cases the blind ends had been demonstrated clinically one by roentgen rays and the other by the palpation of a large sausage shaped mass. In the third case ulceration had developed in the blind loop and the patient had symptoms of obstruction. In all 3 cases cures followed excision of the blind redundant loops.

A search of the files of the Mayo Clinic revealed records of only 5 cases in which symptoms could be definitely attributed to blind segments of small bowel left after division of the bowel and side-to-side anastomosis be-

tween either the colon and small bowel or segments of small bowel. These 5 cases were selected from a larger number in which symptoms usually suggestive of partial intestinal obstruction and a redundant segment of bowel beyond the side-to-side anastomosis were noted. However in each of the excluded cases some other more probable explanation for the symptoms was found. In some cases a recurrence of the original disease, usually regional enteritis, had developed in others, the segments of the bowel which had been used in the anastomosis were bound down by adhesions or the anastomosis was greatly distorted. Finally some cases were excluded because of a malfunctioning stoma. It is possible that in some of the excluded cases the blind segment of bowel distal to the anastomosis was the underlying etiologic factor. However the findings, in such cases, at the time of the subsequent operation were so complex that the symptoms could not be attributed solely to the blind loops. Since we were primarily interested in the syndrome associated with the blind segments alone it was thought desirable to exclude all such complicated cases.

REPORT OF CASES

CASE 1. A white woman, aged 37 years, was first seen in August 1943. She complained chiefly of crampy pains and a mass in the right lower quadrant both of which had been present for 4 years. A diagnosis of regional enteritis was established. Resection of the terminal part of the ileum, hemicolectomy on the right and side-to-side ileocolostomy were carried out. A soft rubber drain brought out through a stab wound in the right flank, was left in the region of the anastomosis. The patient was discharged after an uneventful convalescence. She returned 6 weeks later because gas and feces were passing from the site of the previous drain. Gas had first passed from the stab wound about 1 month after the operation, and shortly afterward fecal material had begun to exud from the sinus. Crampy pain had been experienced intermittently in the right lower quadrant which was relieved by the expulsion of gas either through the rectum or through the draining sinus.

There was no systemic evidence of infection at the time of admission. The incision was well healed but the feces and gas exuded from the fistulous tract at the site of the previous drain. A small abscess had developed in the right groin. The leucocytes numbered 7,500 per cubic millimeter of blood. Roentgenographic examination of the colon revealed a freely functioning anastomosis between the colon and

become established prior to the operation or unless gross fecal soiling has occurred at the time of operation.

In all clinical cases which have been reported including those in the present series, some time elapsed between the operation and the development of the complication. When localized infectious processes occurred ulceration evidently developed first with subsequent perforation of the ulcer. The ulceration alone seemed to produce no definite symptoms and the first evidence that any complication had developed was produced by the inflammatory process outside of the bowel. Thus in Case 2 of our series all symptoms were obviously produced by the local peritonitis, in Case 1 the earliest symptoms were those associated with an external fecal fistula and in one of Gunzburg, Colp and Sussman's cases, an inflammatory mass secondary to ulceration produced obstruction. We have no evidence in our material that the inverted end of the proximal segment ever gave way and the only case of rupture of a redundant loop that we were able to find in the literature was that reported by Turner which clearly resulted from trauma.

In all the other cases in the present series as well as in those we were able to find reported in the literature a fairly uniform syndrome was noted. The symptoms developed at varying times after operation and were generally speaking suggestive of partial intestinal obstruction. When the redundant loop was sufficiently hypertrophied distention was evident clinically; this occurred in Case 1 of the present series and in a case reported by Estes and Holm. More frequently than not there was no evident distention. All patients with chronic symptoms complained of colic of varying intensity. Diarrhea was associated with the colic in Case 4 of our series and vomiting accompanied the colic and distention in Case 3.

In cases in which perforation and symptoms consequent to peritonitis do not occur the diagnosis depends on the demonstration of the redundant loop by roentgenography after administration of barium. In cases in which the redundant loop is of clinical significance it should be demonstrable on roentgenologic



Fig. 2. Redundant, dilated blind loop of small bowel following side-to-side ileocolostomy (Case 5).

examination after barium has been given either as an enema or by mouth (Fig. 2). It is conceivable that the redundant loop could be packed so solidly with inspissated stool or secretion that barium could not enter. However this is probably an unusual circumstance and in such cases the redundant loop should be palpable on clinical examination. A note of caution could well be sounded concerning the use of barium by mouth in patients who have undergone previous resections of the bowel and who have since had symptoms suggestive of partial obstruction. The symptoms in such cases are far more likely to be due to partial obstruction produced by adhesions or an inadequate stomach than to redundant loops and in such cases barium by mouth may be strongly contraindicated.

Some restraint should be exercised as well in attributing the symptoms to a redundant segment which may be demonstrated by roentgenography. We have noted repeatedly at the second stage of a staged resection of the right colon that redundancy had developed

re-established by an end-to-end anastomosis between segments of ileum. Patient has remained well since.

CASE 4. A white woman, aged 66 years was first seen in November 1944. For 3 years she had had diarrhea and crampy abdominal pain chiefly localized in the right lower quadrant of the abdomen. For the preceding 7 years in addition she had experienced in the right upper quadrant, attacks of pain of a different type which were characteristic of those associated with cholelithiasis. Abdominal exploration had first been carried out elsewhere in 1933 because of the recurring attacks of pain in the upper right quadrant. At that operation the right portion of the colon and terminal part of the ileum had been resected and intestinal continuity had been re-established by means of side-to-side ileocolostomy. Shortly after that operation the intermittent attacks of crampy abdominal pain, localized in the right lower quadrant along with diarrhea had first developed.

On physical examination the blood pressure was found to be 115 millimeters of mercury systolic and 120 diastolic. The heart and lungs were normal. The abdomen was moderately tender in the right lower quadrant. Urinalysis erythrocyte count, and a hemoglobin determination gave normal values. The leucocytes numbered 15,500 per cubic millimeter of blood. Roentgenographic examination of the chest and stomach gave negative results and examination of the colon revealed a normally functioning stoma between the ileum and transverse colon. A cholecystogram disclosed a nonfunctioning gall bladder and cholelithiasis.

At operation the ileocolic stoma which had been made previously was examined and found to be adequate. The inverted end of ileum was hypertrophied and extended for a distance of approximately 15 centimeters beyond the anastomosis. The redundant loop of ileum was excised and the end turned in. The gall bladder was also removed.

The patient returned to the clinic for a check-up in November 1945. No pain had been experienced since her dismissal. In August, 1946 in response to an inquiry the patient indicated that she was experiencing some distress in the right lower quadrant.

CASE 5. A white man aged 31 years, first came to the clinic September 9, 1935 complaining of intermittent crampy abdominal pain since May 1915. In 1939 a diagnosis of regional enteritis had been made elsewhere and in 1941 an abdominal exploration had been carried out. Nothing was done surgically to treat the regional enteritis at that operation. His symptoms became progressively more severe and in 1943 a stage hemicolectomy on the right and side-to-side ileocolostomy had been carried out elsewhere. Symptoms recurred and became so marked that a second resection of the terminal portion of the ileum including the site of previous ileocolostomy, had been performed in April 1945. Continuity of the bowel was again re-established by means of side-to-side ileocolostomy. The intermittent crampy pains which caused the patient to come to the clinic had developed about a month later.

Physical examination on admission gave essentially negative results with the exception of slight tenderness in the right lower quadrant of the abdomen. The value for hemoglobin was found to be 10.4 grams per 100 cubic centimeters of blood. The leucocyte count was 4,200 per cubic millimeter of blood and urinalysis gave negative results. Roentgenographic examination of the colon revealed a normally functioning stoma between the ileum and transverse colon and a dilated blind loop of ileum proximal to the anastomosis. In view of the number of operations the patient had undergone and the mildness of the present symptoms, conservative management was advised. The patient returned approximately 6 months later, partly because a further check-up had been advised but chiefly because the attacks of crampy pain had occurred with increasing frequency and had become increasingly severe during the interval. Borborygmi and distention accompanied the attacks at that time. Relief occurred when the gas seemed to pass some obstruction. Roentgenographic examination of the colon again revealed a normally functioning stoma between the ileum and transverse colon and the presence of the dilated blind loop of ileum. A delayed film showed prolonged retention of barium in the blind segment of ileum (Fig. 2).

Exploration was advised and carried out in April 1946. The redundant segment of ileum was hypertrophied and dilated. The blind loops of ileum and colon along with the site of anastomosis were resected and an end-to-end anastomosis was established between the ileum and transverse colon. The patient made an uneventful recovery and has since regained his normal weight and has remained well.

COMMENT

In view of the reports of cases in the literature and those in the present series, there can be no doubt that potential hazards, associated with the closed end of the proximal segment of bowel are inherent in the operation of side-to-side anastomosis after division or resection of the bowel. To produce symptoms in dogs, long segments of bowel must be left beyond the anastomosis, and this fact probably explains why clinical cases are uncommon, in that such gross errors of technique are seldom made. Whether the closed end of the proximal segment has any particular tendency to leak early postoperatively and so produce peritonitis cannot be stated. The findings at necropsy in such cases are often inconclusive because of the extent of the local inflammatory reaction. However early death from peritonitis following resection and side-to-side anastomosis is unusual unless peritonitis has

distal to the anastomosis in the end of the proximal segment of bowel after division of the bowel and side to-side ileocolostomy (Fig 1b). Such a finding formerly gave us concern and we have occasionally excised such small redundant segments at the same time that the second stage of the operation was done. However these short redundant segments had produced no symptoms they have been observed at necropsy in patients who had lived for prolonged periods without symptoms after operation and in studies in animals short loops do not become the sites of complications. We now believe that some redundancy may develop in the end of the proximal segment virtually irrespective of how little bowel has been left beyond the anastomosis and that such redundancy causes no symptoms and gives rise to no complications. It is evident that the mere presence of some redundancy is not an indication for its removal.

The method used to re-establish continuity of the bowel after resection of the terminal portion of the ileum and the right part of the colon varies with the surgeon end-to-side end-to-end and side-to-side anastomosis are all commonly used and each has its advocates. Results following the three methods are comparable and the risk associated with each seems much the same at least in the hands of surgeons thoroughly familiar with the particular method used. Since other satisfactory methods are available it follows that side-to-side anastomosis should probably not be used if the method is to be associated with serious potential hazards. The scarcity of reported cases of serious complications, the rarity of serious complications among our cases and the gross error of technique which must be made to produce the complications in dogs would all argue strongly that complications associated with the blind end of the proximal loop following side to-side anastomosis are not of great importance and cannot be used to condemn the method. While we are not committed to the exclusive use of any one of the three methods to restore continuity of the bowel after resection we tend to employ side to-side anastomosis particularly after right hemicolectomy (Fig 1a). With this type of anastomosis the mesenteric attachment to the

bowel wall presents no problems and the stoma can always be made of ample size. In short this method of anastomosis seems easier technically to us than either the end-to-side or the end-to-end methods. It was chiefly because of this preference that the effort was made to evaluate the hazards associated with the inverted end of the proximal segment of bowel. It is evident that complications associated with the inverted proximal end are successfully avoided in the great majority of cases.

CONCLUSIONS

- 1 The potential hazards associated with the inverted end of the proximal segment of bowel following division of the bowel and side to-side anastomosis are dilatation and hypertrophy ulceration and perforation.
- 2 Some dilatation and hypertrophy of the proximal end of the bowel distal to the anastomosis develop in many cases but symptoms are rarely produced.
- 3 When longer than usual lengths of the proximal segment are left distal to the anastomosis symptoms suggestive of partial obstruction may develop. The colicky pains occur in attacks and may be accompanied by vomiting and diarrhea.
- 4 Complications associated with the inverted end of the proximal loop are unusual as judged by the rarity of the reported cases and by the rarity of cases in our own series. They are largely preventable by avoiding redundant segments of the proximal end of the bowel distal to the anastomosis.
- 5 Such complications are so unusual that they do not detract from the usefulness of side-to-side anastomosis.

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CALCIFICATION OF THE SUPRASPINATUS TENDON INFILTRATION THERAPY WITH LOCAL ANESTHESIA AND MULTIPLE NEEDLING

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THE object of this paper is to discuss in detail the infiltration therapy of calcification of the supraspinatus tendon with local anesthesia. The supraspinatus tendon which is really only one component of the musculotendinous cuff and which is inserted into the greater tuberosity of the humerus is the victim of degeneration, calcification and rupture. These three conditions are quite separate clinical entities but probably result from the same basic anatomical peculiarity of this tendon. The etiology, incidence, pathogenesis and treatment are described.

GROSS ANATOMY

The supraspinatus tendon which is one component of a fused structure aptly called by Codman the musculotendinous cuff is inserted into the greater tuberosity of the humerus. In this region of the shoulder there are many important and interesting anatomical features. The subacromial or subdeltoid bursa which is really a synovial bursa lies beneath the deltoid muscle, the coracoacromial ligament and the acromion process itself intervening between these structures and the supraspinatus tendon. The supraspinatus tendon forms part of the floor of this bursa. This bursa is roughly circular and appears to increase in size with age. Its main function is to permit the upper end of the humerus with its capsule to glide easily under the coracoacromial ligament and the acromion process during the movement of abduction. The subacromial bursa is considered to be indispensable in abduction and rotation of the humerus, but it has been removed on more than one occasion without interfering with the function of the arm. The three short rotators, supraspinatus, infraspinatus and teres minor tendons flatten out as they approach their insertion and blend almost indistinguishably with the floor of the subacromial bursa and

capsule of the shoulder joint. The edges of these tendons are so closely approximated here that it is often difficult to tell where one stops and the next begins. It is this fused structure that is referred to as the musculotendinous cuff. The average length of the supraspinatus tendon is $2\frac{1}{4}$ centimeters.

The attachment of the tendons of these short rotator muscles takes place through most of the upper half of the sulcus which is called the anatomic neck of the humerus. The heavier portions of the tendons are inserted on facets situated on the great tuberosity.

The majority of the pathological lesions around this vulnerable area of the shoulder region result from either acute or chronic trauma and involve not only the musculotendinous cuff but also the subacromial or subdeltoid bursa. The one may be secondary to the other so that when considering pathology here all possible lesions must be visualized.

The supraspinatus tendon is subject to degeneration, rupture and calcification and the subacromial bursa above it to acute or chronic bursitis. The pathology of an acute rupture of the supraspinatus tendon was first recognized by Smith in 1835 and fully described as a clinical entity by Codman in 1911. Acute rupture, partial or complete, due to a sudden abduction violence must be distinguished from a rupture of a few fibers of the tendon already degenerated by the gradual attrition of the movement of abduction against the prominent acromion process and its associated coracoacromial ligamentous arch. The actual causation of such degeneration is not fully understood. Senile degeneration of the tendon is postulated as one theory but it occurs in very young adults. It is also suggested that deterioration of blood supply to the tendon may play some important part. Most surgeons however are of the opinion that degeneration

is due to the wear caused by long continued use of the arm in abduction and associated with friction against the coracoacromial arch. Heredity has not yet prepared the human shoulder against the tension and friction of the supraspinatus tendon of the typist, machine worker or hairdresser. Whether occupation alone causes an ischemia due to compression of vascular supply or attention because of friction is still problematic.

CALCIFICATION OF THE SUPRASPINATUS TENDON

Painter in 1905 was the first to recognize calcium deposits in x-ray films of the shoulder. He believed the shadows he observed were due to a thickening of the subdeltoid bursa. Codman, however, who was present at one of Painter's operations, was the first to realize that the deposit was actually in the supraspinatus tendon. It has been observed that gross pathological anatomy reveals a deposition of calcium in the short tendons of the shoulder capsule, most frequently situated in the supraspinatus tendon. On the base of the subacromial bursa in the tendon involved there is an elevation with a grayish white center and a red turgid periphery (2) resembling a boll (5). It is important to note that the bursa itself contains a fibrinous exudate. The calcium deposit at this stage is soft and creamy and resembles staphylococcal pus, or it may be firmer and of the consistency of tooth paste. The acute symptoms are probably caused by involvement of the base of the subacromial bursa. The calcium deposit may rupture into this bursa, producing a chemical bursitis (according to Bishop) and the site of rupture may often be demonstrated at operation (Brickner).

Microscopically the calcium deposits may occur as a number of foci of varying size embedded in a tendon which shows fibrosis and is infiltrated with masses of chronic inflammatory cells, mostly lymphocytes and plasma cells with a few giant cells. The connective tissue may show hyalinization according to a description by Moschowitz.

Chemically the composition of the calcium has been reported by many authors (6, 14, 17) as occurring in the form of calcium carbonate and calcium phosphate and some analyses

show calcium oxalate. The analyses have differed greatly as to the proportion in which these calcium salts occur.

INCIDENCE

The only reliable figures of the incidence of calcification of the supraspinatus are those of Bosworth—among 6,661 supposedly normal persons of the "white collar" class, calcification was found on routine fluoroscopic examination in 165—2.7 per cent in one or both shoulders. In this series the lesions were found most frequently in the period of greatest activity of adult life, nearly all of his subjects being under 50 years of age. It occurs more often in males—3.6 per cent in 1,178—while among 3,883 females it was only 2.5 per cent.

Not every calcification is therefore a subject of symptoms. The soil, however, is fertile for rupture of tendinous fibers with subsequent acute or chronic symptoms.

ETIOLOGY AND PATHOGENESIS

Occupation. Typists, hairdressers and machineists appear to have a significantly higher incidence of calcium deposits. Long continued use of the arm in abduction seems to be a predisposing feature.

Infection. The assumption that infection plays any part—locally or through septic focus—has never been proved. Many who have operated on these deposits and made bacteriological cultures have found negative results.

The sequence of events leading up to the actual deposition of calcium appear to be primarily an interference of blood supply to the tendon. There is, however, controversy how this is brought about. Codman and Wright advanced the hypothesis that calcium is laid down in the unabsorbed hemorrhage which fills the defect in an abortive attempt at repair of minor traumas to the tendon tissue which normally has a poor blood supply. Moschowitz and Elmslie arrived at a similar conclusion. Carnett recorded his opinion that the deposits are as a rule quiescent in their formation and are due to tendinitis, local necrosis of tendon and calcification produced by repeated occupational traumas which squeeze the supraspinatus tendon between the tuberosity of the humerus and the roof of the sub-

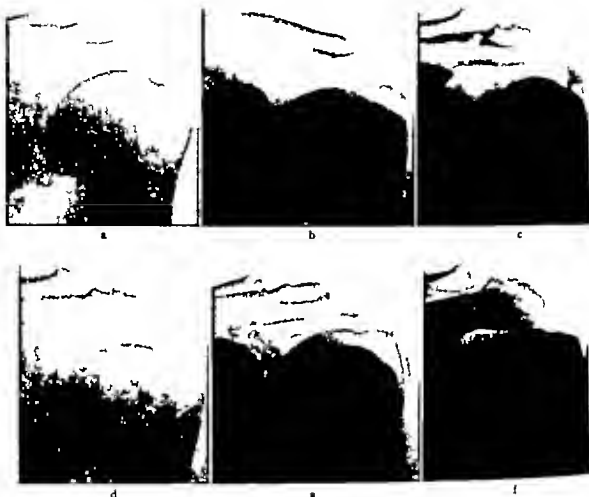


Fig. Case 2. Mrs. J. Y. a. Calcified supraspinatus day before treatment; b, day after infiltration and movement; c, 8 days after N.T. absorption of periphery; d, 3 days after infiltration treatment, calcification becoming

more "woolly" and elongating; e, 23 days after calcification, overflowing its banks; f, 36 days after initial treatment, almost complete absorption after having "overflowed" its banks.

the deposit has formed mild trauma will produce in some the acute inflammation with characteristic symptoms or in others chronic signs and symptoms. Acute symptoms may even be superimposed on the chronic condition. Calcium deposits have been observed to disappear with and without treatment. The acute inflammation with its increased blood supply and accumulation of inflammatory cells steps up the local metabolite rate with subsequent production of carbon dioxide in sufficient amount to lead gradually to dissolution of the calcareous deposits. An acutely inflamed deposit may rupture into the subacromial bursa, setting up a bursitis. This may

also perhaps explain the acute attacks in which there is rapid recovery without treatment.

Acute phase An acute attack may appear without warning even during sleep or it may follow some abduction type of trauma such as preventing an object from falling with the arm in extreme abduction, a fall on the outstretched hand or sudden forcible abduction. It may also develop during the course of a subacute or chronic attack. The patient immediately develops excruciating pain, abrupt and violent, with complete limitation of all movements at the shoulder joint. The pain is felt over the bursa and over the insertion of the deltoid muscle. The pain produces reflex spasm of the

whole shoulder girdle causing pain down the arm and forearm even into the fingers which is so often diagnosed as 'acute brachial neuritis'. It is possible that such a neuritis is really the acute phase of supraspinatus calcification. This reflex spasm is known to produce the typical clinical picture of the scalenus anterior syndrome on the affected side.

Atrophy of the spinatus muscles occurs if the symptoms last more than a few weeks. A lump may be felt just medial to the greater tuberosity if the deposit is in the supraspinatus tendon. If untreated such an acute phase may last for several weeks and then revert to a chronic type with the possibility of adhesion formation or it may clear up fairly rapidly especially if the deposit ruptures into the sub-acromial bursa.

Chronic phase The onset is insidious. First there is an uncomfortable feeling around the shoulder later it is hard to find a comfortable position in which to rest the arm at night during elevation of the arm in the coronal plane. Pain is most often felt at the fibers of insertion of the deltoid muscle while the maximum point of tenderness is over the deposit in the tendon close to the greater tuberosity. If there has been a long painful period the whole area becomes sensitive with pains shooting up into the neck and down to the hand. This has given rise to the misnomer 'chronic brachial neuritis'. In some cases the hand has been seen to swell and the skin to become atrophic. There is usually a certain amount of spasm and limitation of abduction and external rotation at this point. Definite painful 'hitches' associated with abduction through 70 to 100 degrees are commonly present and referred to as Dawbarn's sign when the painful hitch reappears through the same arc on the descent of the arm. Acute exacerbations may occur at any time during the chronic course.

X ray examinations For all suspect cases of calcification of the supraspinatus x ray investigations should be employed and spot roentgenograms taken as suggested by Bishop. The deposit must be seen in profile or it will be obscured by the underlying bone. Deposits of calcification may be single or multiple and if liquid may be seen to change its shape with movement. Sometimes at operation a milky

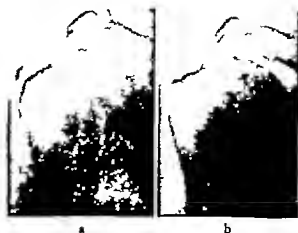


Fig. 3. Case 3. Mr J. J. H. a, Before infiltration and movements; b, 3 days after almost complete absorption. Note here also dissemination of calcified deposit beyond its original confines.

fluid containing calcium has been found which did not show up on x ray examination.

Diagnosis The diagnosis of the acute phase is usually confirmed and fairly easily established by a history of something wrong previously in the shoulder aggravated by some slight trauma. The acute symptoms are often excruciating with almost complete limitation of movement of the shoulder. A localized area of maximum tenderness below the tip of the acromion process—a painful 'hitch' on abduction and again on descent—and the disappearance of the tenderness of the fully abducted arm beneath the tip of the acromion are of sufficient importance to diagnose pathology in the supraspinatus tendon in the lesser acute lesion. The x ray appearances are pathognomonic especially if these are of the semi soft technique. Calcification in a milky form containing calcium has been known to be present without showing up on test x ray films (2).

TREATMENT

Chronic phase The efficiency of treatment of the chronic forms is difficult to evaluate because the patient will get better in spite of any real form of active therapy although it may take up to 2 years for the deposit to become absorbed. Removal of the calcium by operation gives the most satisfactory result although recovery is slower than in the case of an acute deposit. Patients however always prefer some form of heat therapy and over a period of time they recover. The increased



Fig. 4. Case 4. M. J. A. G. a, b Before infiltration therapy c, 11 days after complete absorption

vasculantly with heat therapy and deep x ray therapy and the resulting high carbon dioxide content of the tissue makes the medium acid so that calcium is absorbed. The use of immobilization in abduction causes adhesions and is mentioned only to be completely condemned. Active repeated movement must be the golden rule from the very onset of therapy.

Acute phase. Many forms of treatment have been advocated for the acute attack. Most authors Hitzrot, Bosworth, Codman, Moseley appear to favor excision of the deposit through the same incision as exposure for a ruptured supraspinatus tendon. Irrigation by the two needle method of Patterson and Darvach has been advocated for acute attacks. It is an operative procedure and while good results have been reported by those who favor the method it is not very satisfactory for solid calcium. Short wave diathermy and deep x ray therapy are advocated to produce hyperemia to aid rapid absorption of the calcified deposit.

It is proposed in this paper to describe in detail the treatment employed by the author for the past 5 years for the acute form of supraspinatus calcification. It was felt that in accepting Wells's hypothesis for pathological calcification a more simple method of rendering the medium acid could be achieved than a surgical operation. The method employed is local anesthetic infiltration of the calcifica-

tion and multiple needling of the deposit or whatever capsule may envelope it. This is followed by immediate and continuous movement of the affected shoulder.

Technique of infiltration therapy. The acute cases only are handled with this method as experience has shown that the more acute the pain and the more limited the movement the better are the results.

The patient is either seated or lying, and after thorough cleansing of the skin the area around the acromion process is infiltrated with 1 per cent novocain or procaine solution. The deeper structures are gradually anesthetized and the needle is passed almost horizontally and slightly backward keeping it just parallel to the under surface of the acromion process all the time. These deeper structures must be well infiltrated otherwise the patient experiences excruciating pain. When the deposit is reached it is easily recognized by a grating sensation. The needle is then changed to a fairly wide bore. The deposit is then thoroughly infiltrated with another 10 to 15 cubic centimeters of 1 per cent novocain changing the direction of the needle all the time as the fluid is injected. After the infiltration, the needle is repeatedly withdrawn from the deposit and reintroduced about 7 to 10 times (the needle is not withdrawn from the skin in performing these multiple pricks). The usual care is



Fig. 5. Case 5. Mr C. K. a, left, Extensive calcified mass before infiltration therapy b, 28 days after almost complete absorption

taken to determine any sensitivity to the local anesthetizing fluid employed. It is essential to carry out these injections carefully and gradually and to see that the needle is in the deposit each time it is withdrawn and reintroduced. In about 10 to 30 minutes varying with each case the acute agonizing pain disappears and the completely immobilized shoulder can now be moved fairly freely in all directions. The patient is instructed in all movements of the shoulder especially full 180 degree abduction internal and external rotation. A fully experienced trained physiotherapist is employed to instruct the patient in all these movements. The patients are very happy about the miraculous relief of pain effected by this local anesthetic injection but they must be informed that such relief is to be short lived and that the pain will recur and perhaps be even worse in a few hours.

The stiffness however does not reappear to the same extent and the patients are impressed with the necessity of continuing the movements of the shoulder no matter how limited or painful. These injections are preferably carried out in the morning so that movements can be continued in the afternoon. Sedatives are prescribed for the recurrence of the pain.

The patient is seen thereafter daily to ascertain and instruct movement of the shoulder and if necessary daily x ray films are carried out to note the progress of absorption of the calcified deposit. The pain although worse soon after the injection is better the next day and gradually improves and in the majority of our cases the acute pain disappeared in an av-



Fig. 6. Case 6. Mrs F. C. a, left, Before infiltration b, 23 days after almost complete absorption

erage of 10 days. The relief from pain is proportionate to the rate of absorption of the calcification. If the movements are diligently and intelligently carried out then the rate of absorption of the calcification is complete in an average of 3 to 4 weeks. Radiant heat to the shoulder was utilized in those patients who experienced more pain than anticipated.

RATIONALE OF INFILTRATION THERAPY

The rationale of this infiltration therapy depends on the production of hyperemia in the region of the shoulder. This is achieved by allowing the shoulder to move in all directions as soon as possible and which is made possible only by the use of a local anesthetic. The local anesthetic therefore is not the active principle of this therapy but merely an aid to the production of hyperemia. Secondly the repeated



Fig. 7. Case 7. Mr H. McM. a, left, Before infiltration b, 14 days after complete absorption

TABLE I—SUMMARY OF 7 CASES

Case description	Previous history X ray appearance	Treatment	Relief and rate of absorption of deposit	Follow-up
M. L. W. Houseman	Chronic pain for months. No trauma. Sudden acute agonizing pain. Ex- tremity calcified deposit of supraspinatus	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief. Pain returned in 1 hour, but movements remained improved. Deposit absorbed in 5 days. See Figs. 1a, b.	Pain in 30 days. No movement. No pain.
Mrs. J. V. Housewife	Gradual pain for 6 days. Then sudden acute onset. No trauma. Extremity calcification of supraspinatus.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief. Pain returned worse than before. Deposit remained in surrounding area—overlaid on scapula. Almost complete absorption in 30 days. See Figs. 2a, b.	10 weeks later. No movement of joint. No pain.
M. J. H. Book repairer	No previous history but wrenching accident on train (streetcar) in abducted position. Progressive calcification of supraspinatus.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief for about 1 hour. More movement. Almost complete absorption in 4 days. Pain returned in 10 days. See Figs. 3a and 3b.	Lived out years. No pain. No movement. No pain.
M. J. A. Active farmer	No previous history. No trauma. Sudden acute agonizing pain and wrist clasp. Rounded and fragmented calcification.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief lasting 1 hour. Good movements thereafter. Complete absorption in 30 days. See Figs. 4a and 4b.	X rays 10 months later. No movement. No pain.
M. C. K. Housewife	Previous gradual ache. Then sudden severe pain as if stiff about for 10 days. Very extensive and fragmented calcification.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief for 6 hours. Recurred as bad, but movements better. Almost complete absorption in 30 days. See Figs. 5a and 5b.	Pain for 10 days. No movement. No pain.
Mrs. F. L. Housekeeper	First noticed pain in shoulder 10 months previously. Diagnosed as rheumatism. Swelling without trauma. Acute phase. Fragmented, lower calcification.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief lasting for 3 hours. Complete absorption in 30 days after. See Figs. 6a and 6b.	10 months later. No movement. No pain.
M. H. M. Accountant	No previous history. Sudden wrenching at work. Acute agonizing pain with limited movements. Very faint fragmented calcification.	infiltration 10 cc. procaine 1% with 1 cc. normal saline. Multiple needling.	Immediate relief and movements lasting 3 hours. Recurred worse than before but movements better. Complete absorption in 30 days. See Figs. 7a and 7b.	Pain for 10 days. No movement. No pain.

multiple puncturing of the deposit allows the soft calcification to overflow its banks (Case 2 Fig. 2c) thereby disseminating the calcification into surrounding planes which in turn absorb it at a quicker rate. It has been observed by Wilson that an inflamed calcified deposit may rupture into the subacromial bursa, setting up a bursitis. This may perhaps explain the acute attacks with rapid recovery without treatment as described by Codman.

The mechanical irritation produced by the needle usually results in infiltration of inflammatory cells which increases local metabolism which in turn helps absorb the calcification.

The sum total of all these factors hastens the absorption of the calcified deposit and in actual practice this form of therapy has been highly successful in 15 cases. Many of the failures of this method are probably due first

to inadequate infiltration and needling of the deposit and second to lack of immediate and daily movement of the shoulder joint. The recurrence of the pain which as already stated is very often worse than the original discomfort has led orthopedic surgeons and others to condemn this form of treatment but perseverance and the use of sedatives can overcome this discomfort. Many are apt to expect too much at once with a single needling of the deposit. If this technique is carried out many excisions of calcified supraspinatus deposits can be avoided which is after all an operation like any other. This infiltration and needling therapy is simple quick and can be carried out with the patient ambulatory. Not more than one injection has been necessary in the real acute case although two and three have been used for the subacute phase.

This infiltration therapy has been used in a few cases of acute painful shoulder with localized subacromial tenderness and especially in those associated with a painful 'hitch,' but without a calcareous deposit. In these the results have been most favorable and the relief as dramatic and prompt as the tendinitis with calcification. It is possible that in these shoulders the musculotendinous cuff is in the pre-calcification phase. This therapy has not been used for the calcification found accidentally.

The amount of local anesthetic fluid injected appears to have no direct influence upon the results obtained except that the solutions should be injected directly into the deposit. If there is any doubt as to the exact location of the needle x rays of the needle *in situ* are taken to determine the exact position.

No originality is claimed for this form of infiltration therapy. As far back as 1913 Flint of Yale reported prompt relief of symptoms by aspiration under local anesthesia. A year later Sievers (1914) in Germany, cognizant of Flint's publication described the case of another patient similarly treated with success. Halde, Haggart and Allen and Ferguson have all described the use of local anesthesia for painful shoulders but many appear to have confused acute subacromial bursitis and true calcification. Lapidus in an excellent article on acute tendinitis with calcification describes this infiltration therapy with marked success in 16 cases of the acute phase of calcified tendinitis of the shoulder. He also includes collectively similar conditions around the elbow, hip, knee and wrist joints and refers to them there as acute tendinitis with calcification which are treated with similar favorable results by this infiltration therapy.

Results. Fifteen patients have been treated with this method with a follow up of periods varying from 7 months to 4 years. Table I summarizes 7 of these cases. The accompanying x ray films show the rapid complete absorption with this local anesthesia infiltration multiple needling and movement therapy

SUMMARY

The gross anatomy of the musculotendinous cuff of which the supraspinatus tendon is a component is described. The pathogenesis

and etiological factors of calcification are subject to wide difference of opinion but occupation appears to play an important rôle. The actual deposit of calcium is believed to be due to a low carbon dioxide content and a consequent high alkalinity resulting from a diminished blood supply. The incidence of calcification in individuals with no symptoms is 2.7 per cent in the largest reliable series of 12,122 persons detected on routine x ray examinations.

The close relationship of trauma to the deposition of calcium salts in the supraspinatus tendon may be explained by the rupture of some of the degenerated fibers producing an acute or chronic tendinitis. This phase probably causes the acute or chronic symptoms.

The acute and chronic phases are described and also the various treatments recommended.

A simple nonoperative therapy of local anesthesia infiltration and multiple injections of the deposit is described together with a detailed description of 7 cases. An essential feature of this therapy is immediate and continued movement of the shoulder joint.

Reproduction of x ray films are presented illustrating the rapid absorption of the calcified deposits in the acute lesions only and one series especially depicting the calcareous deposit overflowing its banks into the surrounding tissues.

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THE INDICATION FOR POSTERIOR TRANSPIEURAL BRONCHOTOMY IN THE MANAGEMENT OF INTRABRONCHIAL TUMORS

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By posterior transpleural bronchotomy is meant an opening made in the posterior or membranous portion of the bronchus after this structure has been exposed by transpleural thoracotomy.

Conclusions based on experience with a single case are obviously to be regarded as provisional because such experience is inadequate to justify approval or condemnation of any surgical procedure. However because of the rarity of the clinical picture which lead us to use this approach and the very gratifying end result obtained in this case we feel compelled to add such experience to the literature.

Floeser in 1940 reported the use of this procedure and Goldman referred to the exhibition of bronchotomy in the management of bronchial tumors in May, 1946 but the recent literature fails to indicate any use of this approach otherwise.

Assuming that the recent advances in the control of infection as well as thoracic surgery in general now permit this approach to be practical its position in such evolution would properly fall one step ahead of segmental resection in aiming at eradication of disease with minimal sacrifice of useful lung. Thus after thoracic surgery had passed from its incipient phases and intrathoracic procedures became relatively standardized resection in the form of lobectomy or pneumonectomy was the preferred treatment for many types of pathologic states. As the details of anatomy of the segmental hila became well understood conservation of undamaged lung tissue by resection of the involved segments

only emerged as the ideal. Now as a further step along these lines judgment is required of this ultimate attitude in the conservative lung.

Bronchotomy is not a new term nor is it a recently conceived operative procedure, it must be considered as a revival of an old concept which perhaps only now is of practical application due to the present day adjuncts to surgery namely anesthesia and antibiotic therapy.

Bronchial obstruction has interested physicians for a long time. Without entering into a complete review of the literature the developmental history of the management of this condition can be outlined.

Inhaled foreign bodies were the chief concern of the older physicians. The interest in other forms of bronchial obstruction such as tumors, had to await the introduction of bronchoscopy by Millan (1897) and its expansion by C. Jackson (1904).

DeForest Willard in 1891 conducted animal experiments to explore the feasibility of removing intrabronchial foreign bodies by a transthoracic bronchotomy. Prior to this time inhaled foreign bodies were treated by tracheotomy, often called bronchotomy, followed by blind grappling within the air passages for the offending agent. Such procedures were not very successful and the principle dependence was on spontaneous expulsion, the tracheotomy wound serving as an easier avenue of escape than the rima glottis. In those days the difficulties that were presented to a surgeon dissecting into the hilum of the lung were considered quite unmountable. Nevertheless bronchotomy either by a transpleural or transmediastinal approach was attempted in the succeeding years. Most of them ended fatally either eventually or immediately (1-7).

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Fig 1 Roentgenogram of November 20, 1946 showing the atelectasis of the lower lobe



Fig 2 Roentgenogram of December 10, 1946 showing evidence of progressive obstruction now involving the upper lobe as well as the lower. The lipiodol is residual from an earlier bronchogram

but a successful one was performed for example, by Goeltz in August, 1904.

With the perfection of bronchoscopy attention seems to have become focused on this accurate and logical means of attacking problems of intrabronchial pathology. As the sequelae of bronchial obstruction become understood and emphasized resection of the involved lobe or segment thereof become the treatment of choice not only for foreign bodies inaccessible to endoscopic management but also for tumors not manageable by this approach (8).

If speculation is permissible the idealized indication for bronchotomy in the relief of neoplastic bronchial obstruction would involve a benign pedunculated tumor not manageable endoscopically obstructing a stem bronchus without irreversible lung damage distal to it. A stem bronchus is chosen because in the present state of our experience such a tumor involving a lobar bronchus only would be handled by lobectomy with a very high degree of safety.

The hazards anticipated in performing bronchotomy must include at least (1) the grave danger of pleural and mediastinal contamination by the secretions retained distal

to the obstruction (2) the reticence with which the affected lung or lobe will re-expand following relief of the obstruction enhancing therefore the danger of empyema (3) the leaving of the patient with a severely diseased lobe or lung most probably in the form of bronchiectasis (4) the possibility of tension pneumothorax or mediastinal emphysema

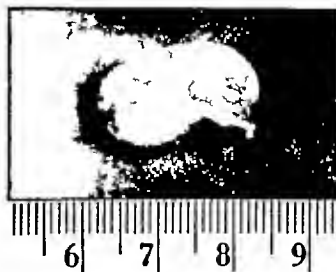


Fig 3 Photograph of excised endobronchial tumor against a centimeter scale. The very narrow pedicle is clearly shown.

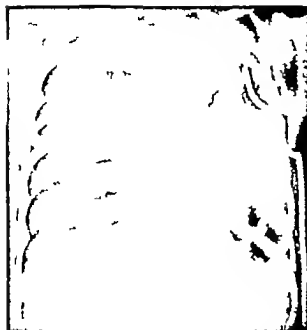


Fig. 4. Early postoperative roentgenogram showing evidence of re-aeration of the left lung. The left pleural cavity contains loculated fluid, not being adequately evacuated by the drains. Although it was feared that organization might occur, satisfactory re-aeration took place.

from a leak at the site of bronchial incision and (5) the possibility of a bronchial stenosis developing at the site of bronchial suture.

CASE REPORT

J. I. F., male, white, age 26 years. The history of chest disease began in March 1946 while patient was working as a welder at which time he noted the rather sudden onset of a cough accompanied by shortness of breath. He consulted a physician who advised hospitalization. Instead of accepting this advice he returned to work after a week. The cough and shortness of breath had abated somewhat but were still present and seemed to become progressively more noticeable. In November of 1946 he was finally worse and his pneumonia was severe. A roentgenogram taken at that time revealed atelectasis of the left lower lobe (Fig. 1). Bronchoscopy was reported as revealing an intrabronchial mass completely obstructing the left lower lobe.

By the time of admission to our care his condition had deteriorated noticeably. Dyspnea was so severe that oxygen was required even when he was recumbent. Fever to 104 degrees of a septic type was present. The roentgenogram (Fig. 2) indicated now that the upper lobe was also obstructed. The septic lung no doubt due to the extensive retention of sputum in this completely atelectatic left lung.

As soon after admission as seemed permissible a bronchoscopic examination was carried out (Decem-

ber 31, 1946). This examination revealed an appearing trachea and right bronchus by 5 to 6 centimeters from the carina on the left, where the lumen was completely obstructed by a firm mass which was smooth, not ulcerated, not glistening in appearance and pink in color. It was firm in consistency but resilient in character. It could not be displaced downward in the bronchial tree even though at no point of its excursion this mass disappeared from view in the bronchus. It could have any attachment to the bronchial wall concerned. The long aspirating cannula could be passed past this mass without significant difficulty and could be aspirated from beyond it. The mass was distinctly cratered that this mass had crept up the bronchial lumen but was probably pediculated. By no means could the pedicle be seized and the obvious longitudinal extent of the mass precluded prompt removal by endoscopic resection. A biopsy was taken.

This procedure brought about some improvement in his clinical condition even though no further re-aeration in this lung was afforded. The patient was reported as indicating a benign tumor ultimately classified as a fibroma (Fig. 7).

On December 24, 1946 the thorax was opened by making an incision in the left lower rib cage and extracting the tumor from the upper reaches of the bronchial tree. It was found that both lobes were completely consolidated so that a pneumonectomy would have to be done. The safest form of resection. Since the tumor was benign by biopsy and in all probability pediculated

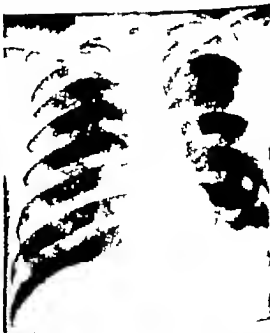


Fig. 5. Roentgenogram taken approximately 1 month after operation showing crystal atelectasis.

it was decided to explore its resectability by open bronchotomy. The lung was rotated forward and the bronchus dissected free. An incision was made into the posterior membranous portion longitudinally where the tumor was palpable. The tumor promptly herniated through this incision as if under pressure. The incision was carried distally following the course of the tumor down to a very narrow stalk from which it arose in the roof of the dorsal branch bronchus to the lower lobe. An area of mucosa was excised at the point of attachment of this stalk (Fig 3). Much purulent sputum was aspirated from the bronchial tree and all branches were cleaned as completely as possible by catheter suction. The bronchial incision was closed with interrupted silk sutures in one layer and the thorax was closed in routine manner with drainage by an anterior and posterior intercostal catheter.

The postoperative course was gratifyingly benign the lung progressively aerating and expanding to fill the hemithorax. The fever subsided as the retained secretions were coughed up. Five weeks following the operation, the chest was virtually normal by roentgenogram; there was surprisingly little evidence of bronchiectasis by bronchography; the bronchial lumen was normal on bronchoscopic examination except for a very small ridge at the site of suture and symptoms were rapidly disappearing. The only postoperative complication was the presence of a mild jaundice of undetermined etiology (Figs 4, 5 and 6).



Fig. 6. Bronchogram approximately 1 month postoperative. Although changes are seen in this bronchial tree they are not very advanced. Cough was rapidly abating and sputum as being raised only in small and decreasing amounts.

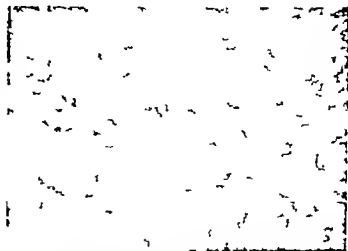


Fig. 7. Histologic appearance of the tumor. After differential staining this tumor was considered as being in the fibrocytic class rather than of smooth muscle origin. Diagnosis fibroma. (Courtesy of Dr. W. L. McNamara, Veterans Administration Hospital, Hines, Illinois)

When compared to the case reported by Bloesser certain differences are noted. In his case the history was one of intermittent bronchial obstruction over a period of 4 to 5 years; there had occurred a suppurative complication requiring surgical drainage from which a bronchocutaneous fistula had apparently persisted; the tumor was not visualized even by repeated bronchoscopic examinations; the neoplasm was ultimately classed as a carcinoma and finally from the standpoint of technique the bronchus was incised transversely and this incision later extended.

In our case the clinical and roentgenologic data indicated a progressive type of bronchial obstruction of relatively short duration (9 to 10 months) and there had been no suppurative complication requiring surgical drainage; the benign character of the tumor and the level of the obstruction was well understood preoperatively and finally the bronchus was incised longitudinally.

Certain points in technique may be worth recording:

1. The position of the patient on the table seems to be of importance and the use of the face down position as described by Overholt so disposes the hilum that the long axis of the bronchus is accessible in a roughly horizontal manner for ease of surgical manipulation. It further tends to favor the displacement of the lung in such a way that the main

lobar branches of the bronchial tree are relatively dependent from the main stem bronchus thereby making control of the retained secretions easier.

The bronchus is cleared over a sufficient length of its course to insure adequate room. It was steadied in our case by a proximal and distal loop of umbilical tape. The use of stay sutures as mentioned by Floesser seems to carry the possibility of incorporating the tumor as well as the bronchial wall in one or both of them. In our dissection of the bronchus no particular attention was paid to the boundaries of the mediastinum, our intention being rather to clear an adequate length of the bronchus as determined by palpation of the tumor.

3 The mediastinum was not closed by suture but was thus allowed free drainage into the pleura.

4 A longitudinal incision in the bronchus seems to offer the best possible exposure and affords an incision that is easily reparable.

5 Ample drainage of the pleura should be provided because these lungs are all probably low in expanding and the hazard of empyema would seem to be thereby lessened.

In our case the lung re-expanded steadily but slowly and the fear that the pleural fluid

may have become organized was overcome (Fig. 4). However this possibility did not materialize.

Antibiotics and chemotherapy both orally and intrapleurally were used rarely. The drains were removed only when they had ceased to function.

SUMMARY

1 A case is reported in which a pedunculated intrabronchial tumor (E—) was managed by posterior transpleural thorotomy with excellent results.

2 A general discussion of the posterior transpleural surgical approach is presented and a few technical considerations derived from the experience in this case are pointed out.

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LARYNGECTOMY

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IN the treatment of carcinoma of the larynx the only hope of survival for the patient lies in complete eradication of the growth. In determining the method of treatment one must bear in mind that untreated cancer is a fatal disease; that the saving of life is the primary consideration of therapy; and that voice impairment or loss of the larynx is of secondary importance.

That eradication of carcinoma can be accomplished in selected cases by laryngofissure has been amply demonstrated by reports in medical literature and a personal experience of 173 cases, of which 188 patients were treated 5 or more years ago. It also has been shown that in certain cases satisfactory results can be secured by irradiation. Viewing the subject purely in the abstract, however, there can be no question that laryngectomy offers a greater degree of security from a life expectancy standpoint than laryngofissure or irradiation therapy but there is much greater disability.

Surgeons are agreed that as a rule one chance is given to cure a patient with carcinoma; this applies definitely to carcinoma of the larynx. Patients and many physicians are of the opinion that there can be a choice between irradiation and conservative or radical surgical treatment with end results about equal irrespective of the laryngeal lesion. There must be definite indications for these therapeutic measures if patients with carcinoma of the larynx are to survive. If one inclines too much to the side of conservatism, influenced by the patient or his family to save the larynx, or lacks the courage to do a more radical operation, the patient often will pay with his life. I cannot agree with those who believe that laryngectomy still can be performed and good results obtained if there is recurrence of the carcinoma following laryngofissure or irradiation therapy. My statistics indicate that in these metastasis to regional lymph nodes is of common occurrence and

that laryngectomy performed as a secondary procedure frequently proves inadequate. It again emphasizes that whoever treats the patient first has the best chance to get him well.

In my experience the most common cause of failure was an inaccurate estimate of the true extent of the carcinoma. It often is difficult to determine the extent even of early carcinoma. In a study of 188 cases of presumably early carcinomas treated by laryngofissure 5 or more years ago, metastasis to regional lymph nodes or distant structures occurred in 12 cases and local recurrence in the larynx in 27. In checking the location of the primary carcinoma in the 27 cases of local recurrence all were found to have involved either the anterior commissure or the subglottic area. It is evident that laryngectomy should have been the primary surgical procedure in these cases. It is of interest to note that local recurrence after laryngofissure was observed more than twice as often as metastasis to regional lymph nodes or distant organs; local recurrence is uncommon if an orthodox laryngectomy has been performed.

INDICATIONS

The indications for laryngectomy have often been discussed and should be well understood. In selecting the method of treatment the criteria to be considered are the extent and location of the growth, disturbances in motility of a vocal cord or arytenoid, the grade of malignancy, the presence or absence of metastasis, and finally the condition of the patient. Determination of the primary location and extent of the growth should be relatively easy since practically all laryngeal carcinomas are of the squamous cell variety and therefore are surface growths. In addition a majority primarily involve the anterior one half of a vocal cord, commonly extend forward and downward and should be readily visualized by either mirror or direct laryngoscopy. In spite of this however it has been the experience of all laryngologists that the extent of the

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Fig. 1. Photomicrograph from laryngectomy specimen case of cordal carcinoma that basically appeared as an early superficial lesion. Clumps of epibell cells were found infiltrating the cricothyroid muscle, a part of which had been removed at the time of operation. $\times 25$.

less than usually is greater than appears on the surface. I often have been impressed with Mackenty's statement that it is wise to add two thirds to the visible portion of the growth in estimating its actual size.

In addition to determining the extent of the surface involvement it is important to recall that submucosal extension continues beyond surface margins. New and Fletcher studied a group of cases of carcinoma and found that with the exception of grade 1 carcinoma there was extension of the growth varying from a few millimeters to as much as 15 millimeters from its apparent margins. The average extension of all grades of carcinoma was 5.5 millimeters.

My experience with lesions in the anterior commissure has shown that in spite of treatment by a radical form of laryngohisture consisting of removal of a triangular segment of the thyroid cartilage together with portions of both vocal cords and an apparently adequate margin of surrounding normal tissue results have been unfavorable (3). Recurrences have been more common in this group than in any other. In spite of the scant lymphatic drainage in the anterior larynx. It is possible that



Fig. 2. The larynx has been skeletonized. A traction on the hyoid bone the margin of the epiglottis is visualized. Before the pleary is opened. A suture on a continuous needle then is passed through the mucosa and fascia between the epiglottis and base of the tongue as shown in the illustration. When this is tied the tissue is gathered. A triangle is then made through the mucosa, along the edge of the epiglottis (shown by dotted line) and separation continued along margins. The upper and lateral limits of the lesion then be formalized.

Broyles, who directed attention to the tendinous attachment of the anterior end of the vocal cord to the thyroid cartilage and the absence of a perichondrium has provided the explanation. Carcinoma in the anterior commissure may extend along this tendon to the cartilage without necessarily manifesting itself as a surface lesion in the anterior end of the cord. Involvement of cartilage is rarely suspected before operation and early involvement may manifest itself only by slight rounding of the cartilage. This normally occurs at the attachment of the cords anteriorly. There also may be extension of the growth to the side of the larynx corresponding to the cricothyroid membrane without demonstrable metastasis to the pretracheal lymph nodes. L.

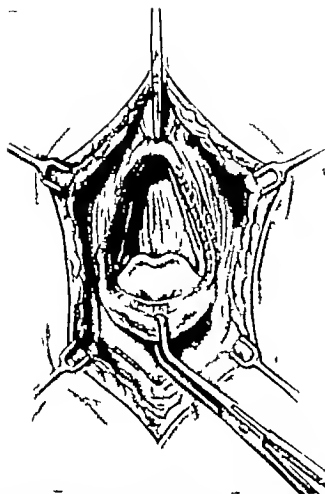


Fig 3. With the tied chromic suture held taut and traction made on the hyoid bone the cut edges of the pharyngeal mucosa can be approximated by continuous suture as it is separated from the larynx.

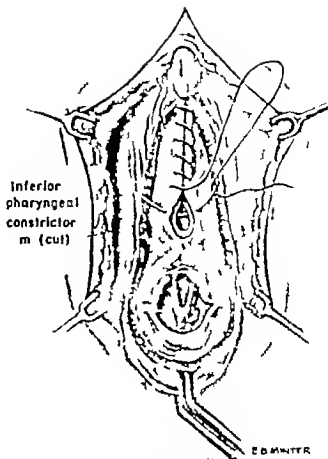


Fig 4. This illustration shows closing of the pharyngeal stoma by continuous chromic suture. (This suture should be held taut by an assistant.) It is important that the raw surfaces and not the mucosa are approximated. With completion of this suture the cut edges of the inferior constrictor of the pharynx and its fascia are approximated and an additional third layer of interrupted sutures is placed to help obliterate the space. Complete skeletonizing down to the tracheal mucosa should be done before the airway is opened.

In addition the carcinoma may extend to the cricothyroid muscle yet appear as an early cordal lesion (Fig 1). New and Fletcher found that in 32 specimens in which carcinoma could be demonstrated inside the cartilage there were 11 in which the growth was also present outside the cartilage. I am convinced that if anterior commissure lesions are treated by laryngectomy there will be fewer recurrences in these cases. In the 27 cases of local recurrence of carcinoma in the larynx following laryngofissure it is fair to assume that complete removal of the primary lesion could have been secured by laryngectomy.

Subglottic carcinoma is diagnosed late as symptoms commonly do not manifest themselves until the lesion has extended to the vocal cords. In my earlier cases I believed that removal by laryngofissure was adequate. Subsequent developments have indicated con-

clusively that a more extensive removal should be carried out and in questionable cases a prophylactic block dissection of the neck be part of the primary operation. I agree with Orton that subglottic carcinoma of the larynx is best treated by laryngectomy.

Carcinoma of the epiglottis commonly begins near its base. It rarely is observed as a marginal lesion. These lesions too are commonly advanced before a diagnosis is made since the vocal cords practically never are involved. Symptoms are meager and the lesion often is overlooked even by laryngologists. There is a tendency for direct invasion of the pre-epiglottic space as the lymphatic drainage from the base of the epiglottis and the anterior extremity of the ventricular band is carried

across the space through the thyrohyoid membrane. (4) Conservative treatment therefore is inadequate and laryngectomy is recommended. III gives the best result.

Koentgen studies of the neck, particularly lateral view and tomogram, are of value to ascertain the extent of carcinoma, particularly in those cases in which one cannot visualize the ultimate portion of the growth. In order to have a soft tissue shadow appear on a roentgen film so that it can be recognized as abnormal it must be of considerable size and unfortunately in a diagnosis of carcinoma the size of a nodule size commonly are advanced. It is important that diagnostic aids be accorded their proper value. Mirror laryngoscopy with or without direct examination is still the best method to ascertain the location and extent of a lesion in the larynx.

On the basis of extent and location of the carcinoma I believe that all lesions confined to the larynx with the exception of those involving the anterior and middle third of a vocal cord without extension to the opposite side and without fixation of the cord should be treated by laryngectomy.

Fixation of an arytenoid indicates involvement of the aryepiglottoid joint and extension to the posterior or larynx. Fixation of a vocal cord is observed when there is infiltration of its musculature by carcinoma. This is a significant sign and I should suggest that conservative surgery probably will be inadequate.

While the grade of malignancy of a carcinoma should be considered in the selection of treatment I do not believe that it is as important as the foregoing. A majority of vocal cord and epiglottic tumors are of a low or intermediate grade of malignancy and undifferentiated carcinoma is not commonly observed. On the other hand carcinoma of a ventricular band or arytenoid frequently is undifferentiated in type.

Metastatic and extralaryngeal extension seriously influence the plan of therapy and the prognosis. I believe, however, it has been conclusively shown that the outlook is better if radical surgery is resorted to. Pre-epiglottic extension of carcinoma of the epiglottis has been successfully treated with radical surgical removal of the pre-epiglottic space and larynx-

gectomy. I consider this type of carcinoma favorable for surgical treatment if the primary lesion in the pyriform sinus or the interarytenoid area where metastases are early. Metastasis to the deep cervical nodes in the region of the bifurcation of the carotid artery complicating carcinoma of the vocal cord or epiglottis does not constitute a hopeless problem and better results are secured by block dissection and laryngectomy than by laryngectomy plus irradiation. In time I performed laryngectomy and block dissection as separate procedures. Since this has been done as a one stage procedure and in the first patient treated in this manner there has been no recurrence for more than 5½ years. I have done this operation a number of times since with excellent postoperative results as well as nonrecurrence of carcinoma although the eurytomy group have not elapsed. I believe therefore that the outlook of carcinoma of the larynx from a surgical standpoint is good. I further believe that if laryngectomy is performed more in preference to conservative surgical treatment in the borderline cases there will be fewer recurrences. In cases with metastases radical resection of the entire area together with removal of the primary lesion can be carried out with safety and the results will be far better than those secured by any one method or combination of methods.

Laryngectomy has been described as a formidable mutilating operation which leaves the patient an economic burden and a social logic wreck. In discussing the psychologic adjustment of laryngectomized patients Schall found them a cheerful and optimistic group who readily make readjustment. This has been the experience. A large number of these patients can be taught to talk and the remainder can have recourse to mechanical or electric devices. I have had but one patient who failed to adjust himself and I regretted his condition to have a laryngectomy. This is the problem therefore should be taken into consideration as a factor when it comes to the treatment.

DISCUSSION

The fundamental principle of the technique of laryngectomy remains unchanged.

The choice of anesthetics must be left to the individual operator. I prefer local anesthesia by infiltration supplemented by barbiturates for laryngectomy. In case block dissection and laryngectomy are required, inhalation anesthesia, preferably by intubation, is desirable. Variations in the technique of laryngectomy are necessary to meet certain requirements. Thyrotomy should be done if there is a question concerning laryngofissure or laryngotomy. Conservation of structures about the larynx, notably attachment of muscles, has I believe certain hazards and violates one of the primary principles of the surgical treatment of cancer. There is nothing to be gained by saving muscular attachments or even the ribbon muscles, and there always is a chance of retaining tissues that are the seat of metastatic carcinoma, notably in the pretracheal region. I therefore remove all of these routinely. In addition, a segment of hyoid bone is removed routinely. In invasion of the preepiglottic space the entire hyoid bone and the preepiglottic space are removed intact.

For a time I employed the Barretto clamp but have discontinued this during the past 16 months (8). My objection to it is that it prevents visualization of the lesion during the removal of the larynx and also requires that the trachea be amputated early in the operation since the larynx must be removed from below upward. I prefer to remove the larynx from above downward so that I can more clearly visualize the lesion in addition it lessens the hazards of aspiration of blood into the trachea. Since discontinuing the use of the clamp I have employed a technique which protects the wound from pharyngeal contamination and retains the laryngotracheal airway until near the completion of the operation. After the larynx is skeletonized and the mucosa of the epiglottis is freed along its lingual aspect, a No. 0 nontraumatic chromic suture is passed through the mucosa and fascia between the base of the tongue and the epiglottis (Fig. 2). When this suture is tied the pharynx is opened and with the suture held taut, it is possible to prevent contamination of the wound by secretions (Fig. 3). This procedure permits one to inspect the lesion particularly if there is a question of extension

laterally which often cannot be satisfactorily visualized in extensive lesions by mirror or direct laryngoscopy. Suturing of the mucosa of the pharynx can be carried out as its separation from the larynx proceeds so that at no time is there any danger of spilling over of secretions (Fig. 4). In addition the airway is protected and there is no aspiration of blood or mucus. Complete skeletonization of the larynx can be completed, the second layer of sutures corresponding to the pharyngeal constrictors can be placed and drainage tubes through an independent counter opening can be inserted before the larynx is amputated. If there is dyspnea a Flagg tube may be inserted at any time.

In subglottic extension particularly when there is stenosis of the larynx which cannot be traversed by direct laryngoscopy it is difficult to determine the level of amputation. To ascertain if the growth extends subglottically I employ a laryngeal mirror through the opening made between the cricoid cartilage and the first tracheal ring to secure a reflected image of the subglottic larynx. This has been helpful in many instances to determine whether the line of amputation should be continued at that level or whether one should remove one or more additional tracheal rings. When growths extend down to the level of the first tracheal ring the prognosis usually is hopeless because of metastasis along the party wall.

MORTALITY RATE

The postoperative mortality of laryngectomy is low and with antibiotics pulmonary complications are uncommon and primary healing is the rule. The most common cause of postoperative mortality is cardiovascular complications. In 326 cases of laryngectomy there was a postoperative mortality of 14 (4.3 per cent). Of these 6 died from pulmonary complications and 8 from coronary occlusions, cardiorenal disorders or apoplexy.

RESULTS

It is difficult to evaluate end results following laryngectomy unless one classifies cases according to anatomical location and extent of involvement. If the carcinoma is confined to the larynx and there is no metastasis to

across the space through the thyrohyoid membrane (4). Conservative treatment therefore is inadequate and laryngectomy a recommended. If I gives the best results.

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While the grade of malignancy of a carcinoma should be considered in the selection of treatment I do not believe that it is as important as the foregoing. A majority of vocal cord and epiglottic tumors are of a low or intermediate grade of malignancy and undifferentiated carcinoma is not commonly observed. On the other hand carcinoma of a ventricular band or arytenoid frequently is undifferentiated in type.

Metastasis and extralaryngeal extension seriously influence the plan of therapy and the prognosis. I believe however it has been conclusively shown that the outlook is better if radical surgery is resorted to. The epiglottic extension of carcinoma of the epiglottis has been successfully treated with radical surgical removal of the pre-epiglottic space and larynx.

I consider this type favorable for surgical treatment. A primary lesion in the pyriform interarytenoid area where metastasis is to the deep nodes in the region of the bifurcated carotid artery complicating a vocal cord or epiglottitis does not constitute a hopeless problem and better secured by block dissection and I than by laryngectomy plus irradiation. I performed laryngectomy and block dissection as separate procedures. This has been done as a one stage operation and in the first patient treated in this manner there has been no recurrence for 3 1/2 years. I have done this operation a number of times since with excellent postoperative results as well as non-recurrence of carcinoma although the customary outlook of carcinoma of the larynx from a surgical standpoint is good. I further believe that if laryngectomy is performed in preference to conservative surgery in the borderline cases there are fewer recurrences. In cases with more extensive radical resection of the entire area with removal of the primary lesion is secured and the results are far better than those secured by any method or combination of methods.

Laryngectomy has been described as a mutilating operation which ruins the patient an economic ruin and a psychological wreck. In discussing the psychological aspect of laryngectomized patients Schall found them a cheerful and optimistic group who make readjustments. This has been the experience of a large number of these patients who can be taught to talk and the remainder can have recourse to mechanical or electronic devices. I have had but one patient who failed to adjust himself and I regretted that he must have a laryngectomy. This phase of the problem therefore should not be considered a factor when determining the proper treatment.

CONCLUSIONS

The fundamental principle is that if the patient is fit for laryngectomy, it should be performed.

THE EFFECT OF ABSORBABLE SPONGE MATERIALS ON THE ACTIVITY OF THROMBIN

JOHN H OLWIN M D and FREDERICK J WAHL, M D., Chicago Illinois

SINCE the isolation of thrombin for practical use by Seegers and his associates in 1938 (18 19 22) the interest in absorbable hemostatic agents has rapidly increased. The war lent impetus to the search for an absorbable sponge that might give the added advantage of the pressure factor in the control of hemorrhage difficult checked by ligature or the topical application of thrombin.

Of these absorbable sponge materials developed in recent years the 3 receiving the most study have been cellulose oxidized by nitrogen dioxide, gelatin and fibrin foam obtained by fractionation of human plasma.

Since these materials followed closely on the heels of thrombin and since thrombin is itself the most active clotter of blood or plasma known at the present time it is natural that they should be used clinically in conjunction with thrombin. They have also been used very effectively as hemostatic agents without the use of thrombin particularly oxidized cellulose and gelatin. This paper deals with the relationship of these three materials to thrombin.

Oxidized cellulose Yackel and Kenyon in 1942 reported the development of an oxidized cellulose which was readily soluble in dilute alkalies and which even with a high degree of oxidation remained fibrous and not friable. The degree of oxidation depending on the content of the carboxyl groups was readily controlled and hence the end product might be varied according to the need for a more or less soluble absorbable or pliable substance. Material containing less than 15 per cent carboxyl groups is not brittle and is easily handled without breaking up. It is slightly degraded by oxidation and may change from its

original white to an off white. It does not stand autoclaving but may be satisfactorily sterilized by formaldehyde. It withstands boiling for 3 minutes.

Frantz (6) placed oxidized cellulose in muscle brain dura joint and peritoneum of animals and found a minimum of tissue reaction. Absorption of the material varied between 10 days and 6 weeks being complete in all cases at the end of this time. The tissue reaction was more marked in the case of the more highly oxidized cellulose apparently because of the higher carboxyl content. In 2 instances the cellulose was soaked in thrombin before being buried in the brain and in these cases the tissue reaction was less than when the cellulose was used alone. Putnam found soluble cellulose dampened with thrombin an effective hemostatic agent. Cronkite Deaver and Lozner used oxidized cellulose with thrombin of both rabbit and human origin and found it effective as a hemostatic agent in both traumatic and elective surgery.

In 1944 Seegers and Doub (20) showed that oxidized cellulose having a carboxyl content of 14 per cent rapidly reduced the pH of a standard thrombin solution to below 4.3 the inactivation point of thrombin. They further showed that when this same cellulose was first soaked in a 1 per cent solution of bicarbonate of soda for a sufficient period of time the pH of the thrombin remained on the alkaline side and its activity was unaltered. They also found that when the oxidation of cellulose is carried further than is required for rapid absorption *in vivo* acidity remains a factor, but there are other products of oxidation which destroy thrombin. Cellulose having a carboxyl content of 21 per cent when first soaked in a 1 per cent solution of sodium bicarbonate did not alter the pH of thrombin but its activity when tested against a standardized fibrinogen solution had disappeared. The nature of the destruction is unknown.

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gen and the conditions under which they are processed, a wide range of products may be obtained. At one extreme is the light fluffy foam that shrinks when wet to about 10 per cent of its dry volume. At the other extreme is a dense firm substance which shrinks only about 50 per cent when wet. Variations in elasticity and flexibility are also possible with variations in physical and chemical treatment. By varying the procedure of production a wide range of thrombic activity may be obtained thus providing for use as a hemostatic alone or in conjunction with a thrombin solution. The material may also be produced with varying fibrinolysin content and varying susceptibility to bacterial fibrinolysin so that its rate of absorption *in vivo* and *in vitro* may be controlled. The material so produced is sterile and does not stand boiling or autoclaving without change of mechanical properties. Bailey and Ingraham (11) implanted fibrin foam and oxidized cellulose soaked in thrombin under the dura of monkeys. They later found adhesions between the dura and arachnoid on the side in which the cellulose was placed. They found no difference in the degree of tissue reaction or the rate of absorption between the two substances.

Bailey and his associates (2) implanted fibrin foam and soluble cellulose both materials with and without thrombin in the liver peritoneal cavity, abdominal wall, kidney and lung of experimental animals. In all instances there was minimal tissue reaction and little difference in that elicited by the two substances. Both were absorbed in 5 weeks or less, the cellulose disappearing in a slightly shorter time than the fibrin foam. The hemostatic effect was satisfactory in all instances. In 240 general surgical cases fibrin foam and thrombin were effectively used as hemostatic agents.

Gelatin sponge. In 1945 Correll and Wise (3) reported the preparation of an absorbable water insoluble gelatin base sponge obtained by foaming a gelatin solution and drying it in special forms. It is white, tough, porous, non-elastic and may be cut into any desired size or shape. It will take on 50 times its weight of water and about 45 times its weight of blood. It was found to be nonantigenic.

Correll, Prentice and Wise (4) placed implants of gelatin sponge, fibrin foam and starch each soaked in thrombin into the muscles of rats. Each elicited a minimal tissue reaction. They found the gelatin sponge completely absorbed in 30 days, starch persisted through the 50th day after implantation and fibrin foam was not completely absorbed at the 100th day. Light and Prentice made similar comparisons on thrombin soaked implants of gelatin and fibrin foam placed deep into the brain subcortically, subdurally and as patches to repair torn venous sinuses. They found no appreciable difference in tissue reaction to the two types of sponge when implanted under similar conditions. Neither was there any difference in tissue reaction when human thrombin was substituted for the bovine product. Both the gelatin and fibrin foam patches effectively stopped the flow of blood from a torn venous sinus and there was no instance of a thrombus occurring in the sinus channel.

Gelatin sponges without thrombin were implanted into various animal tissue by Jenkins and Clarke (13). The tissue reaction was less than that elicited by cat gut and the material was absorbed in about 5 weeks. They found it to be an efficient hemostatic in its own right. Jenkins, Janda and Clarke (14) used it experimentally with and without thrombin and report a more rapid hemostasis when thrombin was used. The difference however was not marked. In comparing gelatin sponge with fibrin foam and oxidized cellulose they found the immediate hemostatic efficiency of the three about equal. The soluble cellulose however did not adhere so firmly to the tissue surface as did the gelatin and the fibrin foam was more easily broken up. Jenkins and Janda (15) made stab wounds in the large veins including the vena cava in dogs and in other instances excised a portion of the vein wall. They used gelatin sponge without thrombin as patches to cover the defects. In most instances the hemostasis was successful and the defects were closed by an endothelialized scar at the end of 3 weeks. After a month it was difficult to identify the sponge grossly. Again they demonstrated that gelatin sponge alone is an effective hemostatic agent though they

TABLE I.—EFFECT OF OXIDIZED CELLULOSE ON THE ACTIVITY OF BOVINE AND HUMAN THROMBIN

Substance	pH	Clotting time (seconds) after addition of 0.1 cc thrombin solution		Note
		Oxalated plasma, C.	5% Fibrinogen solution.	
Distilled water 60	6.05			
Fine thrombin (bovine) 500 units	7.04		3	0-25
		4	6	
Fine cellulose 500 gm	8.2	4	4	0-15
		6	4	
Fine cellulose 12 gm. (total 512 gm.)	8.67	No clot after 3 minutes	No clot after 3 minutes	0-30

The pH of the thrombin is rapidly reduced to below its inactivation point on the addition of a total of 254 gm. of oxidized cellulose about 1/5 the amount packaged by the manufacturer. Note that the thrombin is still active after 0.1 gm. of cellulose has been added and the pH is still above the inactivation level of thrombin. The amount of cellulose is less than that likely to be used clinically for hemostatic in most instances. The compatibility of smaller amounts of cellulose and larger amounts of thrombin was not investigated.

believe that the addition of thrombin enhances and accelerates the hemostatic action

EXPERIMENTAL STUDY

In view of the increasing use of absorbable sponge materials in many instances in conjunction with thrombin it seemed of interest and importance to investigate the effects of the various substances on the activity of thrombin. Included in this study are absorbable cellulose fibrin foam and gelatin used with human and bovine thrombin as described below. Quantities of each substance were in general kept within limits likely to be used clinically for hemostasis. No attempt was made to investigate the extreme limits of compatibility of the substances.

Thrombin human and bovine in varying unitages was dissolved in both distilled water and normal saline solution. The pH of each solvent was measured by means of the glass electrode before and after the addition of the thrombin and at various stages after the addition of the soluble sponge material. The activity of the various thrombin solutions was determined by adding 0.1 cubic centimeter of the particular solution to 0.1 cubic centimeter of standardized fibrinogen solution and

TABLE II.—EFFECT OF OXIDIZED CELLULOSE ON THE ACTIVITY OF BOVINE AND HUMAN THROMBIN

Substance	pH	Clotting time (seconds) after addition of thrombin solution		Note
		Oxalated plasma, C.	5% Fibrinogen solution, C.S.	
Normal saline 60 C.C.	7.89			
Fine thrombin (bovine) 500 units	6.92	37	87	
		16.4	8	
Fine cellulose 0.375 gm.	4.57	64.9	No clot after 3 minutes	12-30
		76.8		
Fine cellulose 275 gm. (total 350 gm.)	3.06	No clot after 3 minutes	No clot after 3 minutes	

In this instance the pH of the thrombin solution was reduced to below its point of inactivation after the addition of 350 gm. of cellulose.

checking the clotting time. Similar tests were made in each instance freshly collected oxalated human plasma being used in the same quantities. The prothrombin in the plasma was rendered inactive by the oxalate, but the fibrinogen was still available for reaction with thrombin.

Various absorbable sponge materials in weighed amounts were added to the respective thrombin solutions and the pH and activity of the solutions measured after each such addition. The time factor was also taken into account. As a rule sponge samples were added until there was little or no further change in the pH of the thrombin solution, and in many instances no further change in the activity of the thrombin. Most experiments were completed within a 2 hour period though in a number of instances the thrombin, when its activity was little affected by the sponge, was stored at approximately 5 degrees centigrade, and its activity followed at intervals for as long as 47 days. No attempt was made to keep the solutions sterile.

In the case of oxidized cellulose various reagents were used in an attempt to neutralize its acid character among these being sodium bicarbonate sodium oxalate, sodium citrate, sodium acetate imidazole and glycerin. The cellulose was soaked in these solutions for varying periods of time before being placed in the thrombin solution.

TABLE III.—EFFECT OF BUFFERING ACTION OF 1 PER CENT DICARBONATE OF SODA ON THE ACID NATURE OF OXIDIZED CELLULOSE

Substance	pH	Clotting time (seconds) after addition of 1 c. thrombin solution	Time
		Oxalated plasma, 0.1 c.c.	1% Fibrinogen solution, 0.1 c.c.
Normal saline 60 p.p.	5.80		
Fine thrombin (bovine) 500 units	6.45	3.4	9.3
		9	0
			9.9
Fine cellulose 777 gm.	4.04	33.0	35.6
		45.5	39.8
		56.0	37.7
Fine cellulose 710 gm.	3.5	0.5	N clot after 3 minutes
		8.1	
Fine cellulose 814 gm. (total 830 gm.)	3.35	N clot after 3 minutes	

Each sample of cellulose was soaked for 1 minute in 1 per cent solution of bicarbonate of soda before being added to the thrombin solution. Note that though considerably delayed, clotting of the plasma does take place after the pH of the thrombin has dropped to 3.5, well below the point of inactivation of thrombin. This would indicate that the inactivation is not immediately irreversible and as shown here the natural best-where action of the plasma has been sufficient to raise the pH to a point where some activity of the thrombin has been restored. The fibrinogen solution is not buffered hence the thrombin solution remains inactive on contact with it.

RESULTS

Oxidized cellulose in small amounts when added to thrombin solutions of varying strengths and volumes reduced the pH to the inactivation level or below within a few minutes. These thrombin solutions were highly active before the addition of the cellulose and became inactive when the pH dropped to below 4.3. This was true in the case of both the bovine and human thrombin and when put in to solutions of either distilled water or normal saline. Typical reactions are shown in Tables I and II. If cellulose was first soaked in a 1 per cent solution of sodium bicarbonate for 30 seconds before being added to the thrombin solution similar results were obtained. The pH of the thrombin dropped rapidly and the thrombin became inactive. When this buffering time was increased to one minute there were varying effects. In all instances there was a lowering of the pH value of the thrombin but usually not below its point of inactivation. In other instances the pH dropped to below

TABLE IV.—EFFECT OF BUFFERING ACTION OF 1 PER CENT DICARBONATE OF SODA ON THE ACID NATURE OF OXIDIZED CELLULOSE

Substance	pH	Clotting time (seconds) after addition of 0.1 c.c. thrombin solution	Time
		Oxalated plasma, c.	1% Fibrinogen solution, c.c.
Distilled water 60 c.	6.30		
Fine thrombin (bovine) 5000 units	7.3	8.4	3.3
		5	.6
Fine cellulose 774 gm.	5.7		5
			6.2
Fine cellulose 718 gm.	5.3	6	3.8
		5.8	5.4
Fine cellulose 718 gm. (total 830 gm.)	4.85	6.2	30.5
		6.8	3.7
	4.54	7.4	34.3
		17.4	34.6
	4.3	4	3.5
		6	3.3

Each sample of cellulose was soaked for one minute in 1 per cent bicarbonate of soda solution before being added to the thrombin solution. The pH of the thrombin solution was reduced by the buffered cellulose but still active after the addition of 830 gm. of the material.

this point. The activity of the thrombin was diminished in all instances and followed in degree for the most part the pH values. Tables III and IV show two representative reactions. Leaving the cellulose in the buffering solution longer (total of 5 minutes) materially slowed the reduction in pH of the thrombin solution but the activity of the latter was still reduced (Table V). This supports the work of Seegers and Doub (20) who found an unexplained factor other than a reduction of the pH value by which cellulose having a carboxyl content of 21 per cent interfered with the activity of thrombin. The cellulose in this study had a carboxyl content of 18.5 per cent.

However oxidized cellulose soaked in the 1 per cent bicarbonate solution for as short a time as 1 minute began to disintegrate and was not well suited to packing into a wound. It assumed an amorphous jelly-like mass that broke up with handling. Dissolving the dry thrombin in a 1 per cent solution of sodium bicarbonate achieved the desired buffering effect but the oxidized cellulose soaked in it

TABLE V—EFFECT OF ADEQUATELY BUFFERED CELLULOSE ON THE ACTIVITY OF THROMBIN

Substance	pH	Clotting time (seconds) after addition of thrombin solution		Hour
		Oxalated plasma	% Fibrinogen solution	
Distilled water 60	6.05			
Fibrin thrombin (bovine) 5000 units	6.0	3	6	975
		3	4	
Fibrin cellulose 273 gm.	7		13	9130
			0.5	
			10	
Fibrin cellulose 274 gm.	7	30	14	9700
			14	
			5	
Fibrin cellulose 275 gm.	6.90	30.6	14	9030
		30		
		30	30.4	
Fibrin cellulose 280 gm. (total 18 gm.)		No clot after 3 minutes	No clot after 3 minutes	100

Each sample of cellulose was soaked in 1 per cent solution of bicarbonate of soda for 5 minutes before being added to the thrombin solution. The cellulose, as adequately buffered in this instance and the pH of the thrombin solution little affected. Despite this the activity of the thrombin declined and finally disappeared after the addition of 13 gm. of cellulose. This supports the work of Rogers and Douth (26) who found an unexplained factor other than the reduction of the pH value, by which cellulose having a carbonyl content of 21 per cent interfered with the activity of thrombin. The cellulose used in this instance had a carbonyl content of 6.5 per cent.

rapidly assumed the same jellylike consistency and was poorly suited to packing.

In an attempt to find another buffer that would not so readily dissolve the cellulose, samples of the material were added to solutions of sodium citrate sodium oxalate sodium acetate and glycerin. The buffering action of the citrate was about the same as that of the bicarbonate, and that of the oxalate, acetate and glycerin considerably less. In all instances however the cellulose began to dissolve within 3 minutes of the time it was added to the buffer. Imidazole a buffer used successfully in certain processes involving blood clotting because it does not precipitate calcium salts, was investigated. Its buffering qualities were better than those of any of the above substances, but the cellulose dissolved as rapidly in it as in the other solutions.

Fibrin foam. When fibrin foam was added to a solution of human thrombin in distilled

water or normal saline, there was a slight lowering of the pH value of the thrombin (Tables VI and VII). The activity was also slightly reduced though the change in both the pH and thrombin action was so minimal as to be of no clinical significance. As more fibrin foam was added to the same thrombin solution, the pH was further lowered and the thrombin activity changed accordingly. The changes after the addition of up to twice the amount usually packaged with one thrombin sample were still so slight as not to impair materially the usefulness of the solution clinically. If such solutions of thrombin were stored at 5 degrees centigrade with the fibrin foam still present in the solution, the thrombin activity remained little changed for from 8 to 12 days. After that, though the pH values were not further lowered but in fact came up slightly the thrombin activity continued to decline. One sample which clotted the fibrinogen solution at 6.4 seconds originally gave a clotting time of 33 seconds after 37 days (Table VII). This represents a fair degree of thrombin activity. Plasma that was originally clotted at 9.5 seconds by the same thrombin solution gave an average clotting time of 21 seconds after the thrombin had been stored for 38 days (Table VII). This apparent higher degree of activity of the fibrinogen in the plasma may be on the basis of the buffering action of the plasma. The fibrinogen solution did not contain a buffer.

Gelatin sponge. When gelatin sponge was added to bovine thrombin in either normal saline or distilled water the pH value of the solution was lowered. This occurred to a greater degree than when fibrin foam was added to thrombin but the pH level in all instances in this study was well above the inactivation point of thrombin. Even though the gelatin reduced the pH of thrombin more than did the fibrin foam, the resulting thrombin activity was much the same. Tables VIII and IX are representative of the changes in pH values and thrombin action when gelatin sponge is added to thrombin solution. When stored at 5 degrees centigrade with the gelatin still in the solution of thrombin, the activity of that solution remained fairly uniform over a period of 4 to 17 days with an average of 13 days. In

TABLE VI — EFFECT OF FIBRIN FOAM ON THE ACTIVITY OF THROMBIN

Substance	μ m	Clotting time (seconds) after addition of c.c. thrombin solution	Hour	Date
		Oxalated plasma, 1 c.c.	1% Fibrinogen sol. 100, 1 c.c.	
Normal saline 20 c.c.	0.7			0-26
Fine thrombin (human) 200 units	7.06	0	5.0	.75
		0.4	2-	
Fine fibrin foam 0.15 gm.	0.67		6	35
			5.8	
Fine fibrin foam 0.4 gm.	0.57		7.4	-4
			7.6	
Fine fibrin foam 0.9 gm.	8.34		0.4	50
			8.8	
			8.4	
Fine fibrin foam 34 gm. (total 335 gm.)	0.43	0.8 7.6	2.4 12.8 3.6	3
	0.43		5 10 0.4	120
	0.43		10 0	00 0-2-46
			0.8	
			1.4.8 0.6	3 0-4-46
			0.8	0.00 0-3-46
			7.4 0.6	
			0.8	8.45 10-8-46
			8.4	
			7.8	
			1.4.8	5 0-4-46
			8	
			0.8	0.1 0-14-46
			4	
			4	00 0-6-46
			1.0	
			12.8	00 0-8-46
			4	10.4 0-10-46
	7.09	6	24.4	0.00 10-22-46
		0.8		
	7.45	1.4.8	1.3	0.00 0-24-46
Q N 5		5.8	12.4	0.00 0-20-46
		0	0	
		3		00 0-20-46
		8	8	
		8	12.4	00 0-3-46
		8.8		
		8	7.1	00 8-46
		2.4	12	
		5	20	00 0-46
		5	8	

TABLE VII — EFFECT OF FIBRIN FOAM ON THE ACTIVITY OF THROMBIN

Substance	μ m	Clotting time (seconds) after addition of thrombin solution	Hour	Date
		Oxalated plasma, 1 c.c.	1% Fibrinogen solution	
Distilled water 20 c.c.	3.04			0-23-46
Fine thrombin (human) 200 units	7		6.8 6.4 6	0:15
Fine fibrin foam 0.05 gm.	0.07	0.4 0.6	7.6 7.8	0.50
Fine fibrin foam 0.9 gm.	0.6		7 8.4	05
Fine fibrin foam 0.9 gm.	0.86	.8 0	0 0.3 2.4	0' 5
Fine fibrin foam 0.5 gm. (total 34 gm.)	0.8		0 8.8 8 8	40
	0.8		8.0 8.8 8	5
	0.82	1.4 6	8 8.4 8.6	43
	0.80	3	8.4 8.4	0-24-46
	0.50		0 0 8.6	0-27-46
	0.5		0.4 8.0 8	8.45 0-25-46
			8	43 0-30-46
			8	00 0-2-46
			8	0:15 0-4-46
			6	0:00 0-2-46
			4	5 0-2-46
			4 0.4 0	0:30 0-14-46
			8 2 2.4	200 0-10-46
			8 7.8 8	73 0-8-46
			8	0.5 0-22-46
	7.57	20 4 8	2.4 3 0	0.00 0-4-46
Q N 5		20.8 4 2.4	3.5 4 5	00 0-10-46
		1.4 4 1	5 4 3	00 0-20-46
		1.8 3	21.6	0-3 4

The μ m of the thrombin was slightly reduced by the addition of fibrin foam, but after the addition of a total of 335 gm. of the latter, fair degree of thrombin activity remained for as long as 36 days.

In this instance total of 34 gm. of fibrin foam affected the μ m of the thrombin slightly and the thrombin activity was not greatly reduced after 34 days.

TABLE VIII.—EFFECT OF GELATIN SPONGE ON THE ACTIVITY OF THROMBIN

Substance	pc	Clotting time (seconds) after addition of thrombin solution		Hour	Date
		Oxalated plasma	1% Fibrinogen solution		
Normal saline 60	9.05				0-48
Fine thrombin (bovine) 000 units	8.03		8	9-10	
			7		
			7		
Fine gelatin 170 gm	8.27	10.8		9-43	
		9	7.8		
			7.8		
Fine gelatin 800 gm	6.80		9.4	05	
			9		
			8		
Fine gelatin 1 gm	1.54			10-3	
			9		
			10		
Fine gelatin 1 gm (total 445 gm)	1.44		8	10	
			10		
			4		
	6	18	4	6	
		6.4	6		
	1.44			-48	
			11.4		
			10		
	6.84			9-27-46	
			10		
			9		
	6.46	8	9	100	0-24-46
			11.8		
			6		
	1.47			100	9-27-46
			11.8		
			6		
	5-48			8-40	9-28-46
			11.8		
			11.8		
	5.48	8	11.9	10-10	0-20-46
			11.0		
			10.0		
Gelatin dissolved			10.0	100	9-2-46
			10.0		
			10.0		
			11	10-11	0-4-46
			10.0		
			10.0		
			10	9-08	0-8-46
			10.0		
			10.0		
	6.88	10	10.0	6	0-12-46
		10	10.0		
		10	10.0		

The gelatin (1 gm.) reduced the pc of the thrombin to a degree less than did the fibrin lepto, but the activity of the thrombin was not materially affected after 14 days.

TABLE IX.—EFFECT OF GELATIN SPONGE ON THE ACTIVITY OF THROMBIN

Substance	pc	Clotting time (seconds) after addition of thrombin solution		Hour	Date
		Oxalated plasma	1% Fibrinogen solution		
Normal saline 60 c.	5.7				9-10
Fine thrombin (bovine) 000 units	8.04		7.6	41	
			7.6		
			7		
Fine gelatin 15 gm	0.4		10.8	7	35
			10.8		
			10.8		
Fine gelatin 1 gm	6.15	11.8	8	10-16	
		4	8		
			8		
Fine gelatin 6 gm	5.80	8	9	10-25	
			9		
			9		
Fine gelatin 70 gm (total 445 gm)	6	8	10.8	10-26	
			10.6		
			14.8		
	5-27		14	10-11	
			14		
			14.0		
	6.3	10	14.8	10	
		17	8		
		18.0	6		
	6.13	14	4	10-26	9-26-46
		5	13		
			13		
	5.20	8.8	13.8	100	9-21-46
		17			
	5.20	13.8	17.8	10-20	9-11-46
		14	16.8		
	8.23		11.8	10-15	9-17-46
			13.6		
			13.6		
	8.13		13	8-15	9-26-46
			4		
			13.6		
	8.13	17.8	14	10-2	9-26-46
		15			
			10	10-20	10-1-46
			10		
			10		
			10	10-5	10-1-46
			10		
			10		
	10.7		10.0	10-1	10-1-46
			10.0		
			10.0		

In this instance 445 gm. of gelatin reduced the pc of thrombin to about the same degree as did 710 gm. (Table VIII), but the activity of the thrombin was reduced to a slightly greater degree on 11 days. In neither instance was the change of clinical significance.

most instances two to four times as much gelatin was added to the thrombin solution as is packaged with it by the manufacturers. Thus the possibility of any significant change in the activity of thrombin brought about by the usual amount of gelatin used is remote.

COMMENT

From this study it would appear that the use of thrombin with oxidized cellulose is a questionable procedure and may be contraindicated. Unbuffered cellulose in small amounts by virtue of its acid nature, rapidly lowers the pH of thrombin and thus inactivates it. Cellulose may be properly buffered so that it does not alter the pH of thrombin to any great degree but if the carboxyl content is sufficiently high, the thrombin is still inactivated by a factor in the cellulose as yet unknown.

Inasmuch as cellulose alone is a satisfactory hemostatic agent (8-9-17) and the acid nature of the material may be responsible for a certain degree of this hemostatic quality it is likely that the thrombin by partially neutralizing it may impair its value as a hemostatic agent.

The finding by Frantz and Lattes (9) that dry cellulose placed at the site of a clean fracture delays the formation of callus would suggest that the unbuffered material should not be used in open fractures or in bone surgery where callus formation is desired. How much of a rôle the acid factor plays in the inhibition of callus formation and how much may be due to other factors is speculative. It is suggested that in conditions in which the formation of new bone is undesirable as in fenestration of the wall of the inner ear and in certain arthroplasties the use of cellulose might be of value in discouraging callus formation. It is suggested that variations in the percentage of carboxyl content of the cellulose might be of value in such conditions thus providing different degrees of acidity and different absorption times of cellulose.

The use of buffering agents in our study was unsatisfactory because of the early disintegration of the cellulose in such solutions.

Fibrin foam and gelatin affected the activity of thrombin only slightly and solutions con-

taining these sponge materials remained active over a period of days. It is suggested that thrombin solutions made up for use in surgical procedures may be preserved at domestic refrigerator temperatures and in sterile condition for repeated use with fibrin foam and gelatin. Such solutions may be easily tested for thrombic activity by adding a few drops of the solution in question to a similar amount of citrated or oxalated blood. Such blood may be fresh or may be drawn from any bottle of bank blood suitable for transfusion. Blood not more than 3 weeks old should be satisfactory. The clotting of such thrombin blood combinations in 25 seconds or less indicates a thrombic activity considerably greater than that of the normal spilled blood and satisfactory for clinical use.

SUMMARY AND CONCLUSIONS

1. Oxidized cellulose because of its extreme acid character rapidly reduces the pH of thrombin to below its point of inactivation—4.3.

2. This acid character may be neutralized by first soaking the cellulose in a buffering solution of 1 per cent bicarbonate of soda. In this study soaking the cellulose for as short a time as 1 minute minimum time required for such neutralization, resulted in a disintegration of the cellulose to such degree that it was poorly suited to packing into a wound.

3. Other buffering agents including sodium oxalate, sodium citrate sodium acetate glycerin and imidazole caused similar disintegration of cellulose. Thrombin dissolved directly in 1 per cent sodium bicarbonate gave similar results.

4. Oxidized cellulose having relatively high carboxyl content, properly buffered by bicarbonate of soda solution does not reduce the pH of thrombin materially, but the activity of the latter is still impaired by a factor as yet unknown.

5. Because of these factors the use of thrombin in conjunction with oxidized cellulose for hemostasis is considered a questionable procedure.

6. Fibrin foam when added to thrombin dissolved in either normal saline or distilled water reduced the pH of the thrombin slightly but the reduction of neither the pH nor the throm-

bic activity was of sufficient degree to be of clinical significance. Such thrombin solutions when stored at 5 degrees centigrade retained sufficient activity for clinical use for an average period of 17 days and in some instances showed a fair degree of activity after 38 days.

7. Gelatin sponge when added to thrombin solution diminished the pH of that solution to greater degree than did fibrin foam though the thrombic activity was impaired to about the same degree. When stored at 5 degrees centigrade samples of such thrombin solution remained sufficiently active for clinical use for an average period of 13 days and in some instances were comparatively active after 37 days.

8. Solutions of thrombin made up for use at the operating table may be preserved at ordinary domestic refrigerator temperatures, in sterile condition and used over a period of days. The thrombic activity of such solutions is easily tested at the time of use by adding a small sample of it to citrated or oxalated blood.

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OPPONENS TRANSPLANT AN ANALYSIS OF THE METHODS EMPLOYED AND RESULTS OBTAINED IN SEVENTY-FIVE CASES

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THE opposable thumb constitutes one of man's most useful attributes. It is then of utmost importance to consider means of restoring opposition to thumbs deprived of it by injury to nerves or by direct loss of muscle.

It is the purpose of this paper to review our experience with tendon transfer for restoration of opposition in 84 cases of wounds of the upper extremities incurred in World War II in 75 of which sufficient data were available to permit analysis. The fundamental principles of this procedure have been brought out by Bunnell and others (3), and need not be elaborated herein.

INDICATIONS FOR OPONENS TRANSPLANT

The obvious indication for opponens transplant is lack of ability successfully to use the thumb, because of loss of its active opposition and abduction. Some individuals with relatively poor abduction and opposition of the thumb can still use their hand gainfully and do not desire reconstructive surgery. Others with a similarly functioning thumb feel handicapped by it in their particular type of work and therefore are in need of reconstruction. It is, then, a problem demanding not only an objective examination of the affected hand but concomitant consideration of the type of work which the patient must do with his hands.

In general, it can be stated that loss of ability to abduct the thumb to a distance of at least 1 inch (2.5 cm) from the palm with the tip of the thumb over the distal end of the third metacarpal bone, constitutes a fairly serious disability. This is particularly true when there is combined with this, a lack of ability to rotate the thumb and to bring it

across the palm so as to touch the tip of the little finger.

Individuals with complete paralysis of all the intrinsic muscles of the hand such as results from damage to both the median and ulnar nerves are in nearly all instances in need of opponens transplant. Roughly however 65 per cent of patients with paralysis only of the median innervated intrinsic muscles substitute adequately although in varying degrees of completeness for loss of the opponens pollicis and abductor pollicis brevis muscles by means of the flexor pollicis brevis in combination with the abductor pollicis longus (Fig 1). The remaining 35 per cent will require such a transplant in most instances.

These statements are based on our experience and that of others (2) that, in contrast to the median innervated long flexors the opponens pollicis and abductor pollicis brevis show actual return of motor function in only a small percentage of cases. This is true whether the injury to the median nerve has been incomplete and not requiring suture, or whether satisfactory neurotaphy has been carried out. Most of the 84 cases concerned herein were thus derived from the 618 cases of injury to the median nerve, some isolated and some combined with lesions of the ulnar nerve, seen among 3,276 injuries to peripheral nerves treated and studied in this neurosurgical center. The remainder were those in which there had been direct damage to musculature in the thenar eminence.

PREREQUISITES FOR SUCCESSFUL OPONENS TRANSPLANT

The prerequisites for successful opponens transplant are a relatively loose and supple hand the thumb of which can be brought passively into abduction rotation and oppo-

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sition a suitable motor power to utilize in transfer and a hand in such condition that it will be functionally improved by this procedure.

In the hand in which the thumb can be brought passively into the desired position with ease, there exists little problem and the results of transplant are excellent. In wounds of the upper extremities of such severity as to cause injury to peripheral nerves, however there may have developed varying degrees of stiffness and fixed deformity of the hand. Such deformities never should be allowed to develop but if once developed they must be overcome prior to opponens transplant. By far the most important individual in overcoming these deformities is the patient himself. He must be made to understand thoroughly that his own constant working with the hand will improve it faster and more completely than will any other factor. Periods of work in a gainful occupation are unsurpassed as a means of obtaining this end. Proper splinting with constant gentle traction by an apparatus so designed as to pull the thumb into abduction and opposition is an adjunct, but only an adjunct to this active use of the hand.

The demand for an adequate motor power necessitates a musculotendinous unit in the forearm with sufficient strength to bring about opposition abduction and rotation of the thumb when the transplant has been properly completed without sacrifice of useful function in the remainder of the hand. When only the intrinsic muscles of the hand are involved in the paralysis there are of course a number of flexor tendons available. In injuries to the median and ulnar nerves in the upper arm in which there has been paralysis of the long flexor muscles, the surgeon should wait, after neurography until reinnervation of these muscles has proceeded to such a point that they have strength adequate for useful function when transferred. Occasionally in cases of extensive damage to soft tissues involving the flexor tendons the extensor carpi ulnaris proves to be the only available tendon when utilized, it functions satisfactorily as a transplant.

It has been pointed out that a third prerequisite for this operation is a hand in such condition that it would be functionally im-

proved by an opposable thumb. Sensation must be present in the hand, particularly in the thumb and in the index and long finger. Furthermore, there must be sufficient power in the fingers themselves to make them of value along with the thumb. In a few individuals, particularly those in whom all four fingers flex in a mass as a result of tendon damage or a previous tendon transfer to the flexors of the fingers, the thumb is probably better utilized in adduction, in which it can perform a pincers type of action against the radial aspect of the proximal phalanx of the index finger. It is, then important to emphasize again the necessity of accurately ascertaining whether the over-all usefulness of the hand will be improved by the new action of the thumb.

Although the absolute prerequisites for the procedure have been enumerated there are other features which are desirable. It is, of course advantageous to have relatively normal subcutaneous tissue for the rerouting of the transplanted tendons. This necessitates, in certain instances, the preliminary covering of the volar surface of the wrist and forearm with transplanted full thickness skin by means of abdominal flaps or tubed pedicles. Occasionally the use of a pre-formed sheath, as has been suggested by Milgram and others, will tend to diminish the tendency for adherence of the transferred tendon to surrounding structures. We have employed this in only a case, and thus our experience is too limited to allow an appraisal of its value in opponens transplant. It is also desirable to have a strong action in the flexor pollicis longus tendon and reinforcement of this, if weak, at the time of opponens transplant is usually of value.

CHOICE OF OPERATIVE PROCEDURES

There are two main types of operative procedures which have been employed in this group of cases. One is the Bunnell type of opponens transfer the second is the Thompson type. The Bunnell procedure (1) involves the use of a motor tendon rerouted on the proximal side of the transverse carpal ligament and so transferred and attached to the thumb that the line of pull on the thumb is directed toward the pisiform bone. A pulley in the region of

the pisiform bone is usually employed. In the Thompson procedure, a sublimis tendon, preferably that to the ring finger is severed with in the flexor tendon sheath in the finger, rerouted on the distal side of the transverse carpal ligament, and inserted both proximal and distal to the metacarpophalangeal joint of the thumb. In this instance the palmar fascia, around which the tendon is rerouted, acts after a fashion as a pulley.

The Bunnell procedure was used in all instances possible. However in not a few of our cases, there was found extensive scarring in the volar surface of the distal third of the forearm. In such individuals with marked forearm scarring and a normal palm we felt that the Thompson procedure was advisable. By employing this we were able to do all our transferring in normal tissue, and we thus avoided entering scarred areas.

Within the large group of transfers which follow the Bunnell principle, there are several useful variations. The basis of one group of these is the use of the extensor pollicis brevis as a means of prolonging the motor power employed. Such motor power can be supplied by means of the palmaris longus (Fig. 2) the flexor carpi ulnaris (Fig. 3) any one of the sublimis tendons or even by the extensor carpi ulnaris. As will be noted however the extensor pollicis brevis is not always suitable for use.

A second group involves the use of a free tendon graft to prolong the motor power. Such a tendon graft can be inserted into the dorsal and proximal aspects of the proximal phalanx of the thumb and then rerouted subcutaneously toward the pisiform bone. A third subdivision within the Bunnell type is a procedure which we have come to consider very satisfactory namely the use of a sublimis tendon preferably that to the ring finger without the use of an intermediary graft. In this type of operation the sublimis tendon is severed within the flexor tendon sheath of the finger very close to its point of insertion and then is withdrawn well proximal to the transverse carpal ligament. It is then rerouted in the manner illustrated (Fig. 4), and is inserted at the proper tension into a drill hole on the dorsal aspect of the proximal phalanx of the

thumb in most instances. In a few cases, for reasons which will be discussed subsequently it has been inserted into the distal end of the metacarpal bone.

TECHNICAL DETAILS OF OPERATIVE PROCEDURES

It is the purpose of this section to point out certain technical factors which seem to improve the results of opponens transplant. The principles common to all tendon transfer procedures will not be repeated but they are none the less of great importance. These include the use of a tourniquet, rigid adherence to aseptic precautions and care in the rerouting of tendons. Proper, moderate tension on the complete transfer also must be obtained.

The placing of the incisions in the skin is an easily controlled factor which is of importance. It is always advisable, of course, to make incisions along skin tension lines, whenever possible. However it has seemed in these cases even more desirable to so fashion these short incisions that they do not directly overlie tendons after rerouting or particularly, the site of anastomosis of tendons. A few of the incisions employed in this group of cases are indicated in Figures 5 and 6.

In rerouting tendons from the pisiform bone across the palm up into the incision in the thumb the finding of the proper plane for transfer is of great importance. This plane lies just superficial to the palmar fascia, and should be deep enough in respect to the skin itself so that the tendon does not become adherent to the overlying skin or so that pressure necrosis of the skin does not develop. This plane can be found by the passing of a long slim instrument such as a uterine packing forceps from the incision at the wrist, across the palm, and into the incision in the thumb.

When the extensor pollicis brevis is used as a means of prolonging the motor power a few technical details are of some importance. First are accurate location and recognition of this tendon. In a few individuals the tendon is nonexistent. If it is present, it must be dissected out in such a manner that when it is pulled upon in the direction of the pisiform bone it produces satisfactory opposition of the thumb. If it is dissected too far distally

ation a suitable motor power to utilize in transfer and a hand in such condition that it will be functionally improved by this procedure.

In the hand in which the thumb can be brought passively into the desired position with ease, there exists little problem and the results of transplant are excellent. In wounds of the upper extremities of such severity as to cause injury to peripheral nerves however there may have developed varying degrees of stiffness and fixed deformity of the hand. Such deformities never should be allowed to develop but if once developed they must be overcome prior to opponens transplant. By far the most important individual in overcoming these deformities is the patient himself. He must be made to understand thoroughly that his own constant working with the hand will improve it faster and more completely than will any other factor. Periods of work in a gainful occupation are unsurpassed as a means of obtaining this end. Proper splinting with constant gentle traction by an apparatus so designed as to pull the thumb into abduction and opposition is an adjunct but only an adjunct to this active use of the hand.

The demand for an adequate motor power necessitates a musculotendinous unit in the forearm with sufficient strength to bring about opposition abduction and rotation of the thumb when the transplant has been properly completed without sacrifice of useful function in the remainder of the hand. When only the intrinsic muscles of the hand are involved in the paralysis, there are of course a number of flexor tendons available. In injuries to the median and ulnar nerves in the upper arm in which there has been paralysis of the long flexor muscles, the surgeon should wait after neurography until reinnervation of these muscles has proceeded to such a point that they have strength adequate for useful function when transferred. Occasionally in cases of extensive damage to soft tissues involving the flexor tendons, the extensor carpi ulnaris proves to be the only available tendon when utilized it functions satisfactorily as a transplant.

It has been pointed out that a third prerequisite for this operation is a hand in such condition that it would be functionally im-

proved by an opposable thumb. Sensation must be present in the hand particularly in the thumb and in the index and long fingers. Furthermore, there must be sufficient power in the fingers themselves to make them of value along with the thumb. In a few individuals, particularly those in whom all the fingers flex in a mass as a result of tendon damage or a previous tendon transfer to the flexors of the fingers, the thumb is probably better utilized in adduction in which it can perform a pincers type of action against the radial aspect of the proximal phalanx of the index finger. It is, then important to emphasize again the necessity of accurately ascertaining whether the over all usefulness of the hand will be improved by the new action of the thumb.

Although the absolute prerequisites for the procedure have been enumerated there are other features which are desirable. It is, of course, advantageous to have relatively normal subcutaneous tissue for the rerouting of the transplanted tendons. This necessitates, in certain instances, the preliminary covering of the volar surface of the wrist and forearm with transplanted full-thickness skin by means of abdominal flaps or tubed pedicles. Occasionally the use of a pre-formed sheath, as has been suggested by Millgram and others, will tend to diminish the tendency for adherence of the transferred tendon to surrounding structures. We have employed this in only a few cases, and thus our experience is too limited to allow an appraisal of its value in opponens transplant. It is also desirable to have a strong action in the flexor pollicis longus tendon and reinforcement of this, if weak at the time of opponens transplant is usually of value.

CHOICE OF OPERATIVE PROCEDURES

There are two main types of operative procedures which have been employed in this group of cases. One is the Bunnell type of opponens transfer the second is the Thompson type. The Bunnell procedure (1) involves the use of a motor tendon rerouted on the proximal side of the transverse carpal ligament and so transferred and attached to the thumb that the line of pull on the thumb is directed toward the pisiform bone. A pulley in the region of

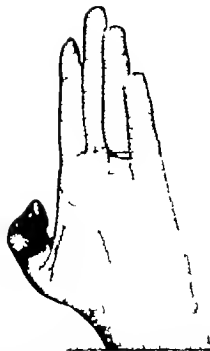


Fig. 1 Satisfactory substitution in an individual with complete paralysis of the opponens pollicis-abductor muscle complex. The thenar muscle mass seen is the flexor pollicis brevis, innervated by the undamaged ulnar nerve.

thumb with the exception of the method of tendon insertion. In our cases half of the sublimus tendon was inserted into a drill hole in the proximal end of the proximal phalanx of the thumb and the other half was inserted through a drill hole in the distal end of the metacarpal bone. These were fixed with the pull-out wire technique of Bunnell or on other occasions they were pulled through the drill holes and anastomosed one to the other in the subcutaneous tissues of the ulnar side of the thumb.

The application of fixation at the conclusion of the operative procedure is of utmost importance. As the dressings are applied the thumb must be worked into a position of opposition, abduction and particularly rotation with the use of numerous fluffed sponges and elastic bandage for accurate maintenance of this position. The metacarpophalangeal joint should be kept in a very slightly flexed position. A molded posterior plaster-of-paris splint is used to reinforce this dressing and straps are incorporated within it to provide a means of elevation of the hand for 72 to 96 hours postoperatively. When the entire dressing and splint have been applied the

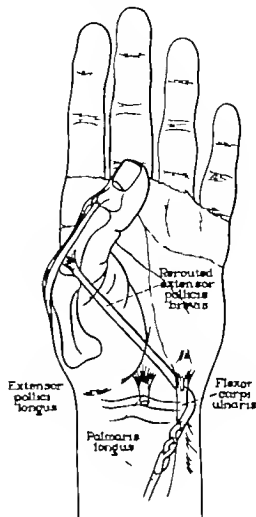


Fig. 2 Completed tendon transfer in which the palmaris longus, rerouted around the flexor carpi ulnaris, is used and is prolonged with the extensor pollicis brevis.

thumb should be well out in abduction and rotation and the wrist should be flexed to about 45 degrees.

POSTOPERATIVE CARE

The dressing is first changed at 21 days at which time the pull-out wires are carefully withdrawn and the skin sutures are removed. The patient is then fitted with an adhesive and rubber band type of splint, fashioned so as to pull the proximal phalanx of the thumb toward the pisiform bone (Fig. 8a and b). He is then carefully instructed by the operating surgeon as to precisely what tendon has been transferred and how he may learn to use this tendon for opposition of the thumb. He is urged to practice diligently with this transferred tendon and for purposes of supervision in this he is referred to the Physical Therapy

across the metacarpophalangeal joint of the thumb. It will markedly flex this joint which is undesirable. In a few instances if the tendon is not dissected far enough distally, it will hyperextend this joint. Therefore, dissection must be carried out to just such a point that the desired rotation and opposition are obtained without either of the aforementioned undesirable actions. Occasionally also a slip connecting this tendon to the extensor pollicis longus must be severed so that it does not exert an extending action on the distal phalanx. In a few instances, despite severance of all connections to the long extensor tendon of the thumb, the extensor pollicis brevis continues to extend the distal phalanx. In such instances, it is probably best not to utilize this tendon but to use a free tendon graft for prolongation of the motor power.

In most instances in which a sublimis tendon, usually that of the ring finger, has been rerouted and directly inserted into bone, the end of the tendon has been inserted into the proximal aspect of the proximal phalanx of the thumb. This has been carried out by the drilling of a small hole from well on the dorsal aspect of the phalanx down through both cortices, in such a way that the tendon inserted into it from the dorsal to the volar side imparts not only abduction to the thumb but also rotation and opposition. The tendon is pulled down into the medullary cavity of the phalanx through the dorsal drill hole, and the pull-out wire technique of Bunnell is utilized to anchor it in place (Fig. 4).

A seemingly minor detail but one of great importance when the aforementioned method is used is the mobility of the metacarpophalangeal joint of the thumb. In a few cases this joint has been so mobile that it was impossible to insert the tendon into the proximal phalanx without the imparting of marked flexion at the metacarpophalangeal joint. In spite of a very proximal location of the drill hole. This possibility is explored by determination of whether or not traction on a suture passed through the drill hole in the phalanx exerts a satisfactory rotatory and opposing action on the thumb. If it does not, but instead causes marked flexion of the metacarpophalangeal joint, the tendon should not be inserted there but must be

inserted into the distal end of the metacarpal bone in a manner similar to that outlined in the phalanx. Despite any theoretic objections (1) to this site of insertion, the functional results have been excellent (Fig. 7).

In most procedures involving the Bunnell principle, some type of pulley must be utilized in the region of the pisiform bone. In instances in which the flexor carpi ulnaris is not utilized as a motor and in which it is functioning, the simplest and most satisfactory pulley is made by merely running the motor tendon over the flexor carpi ulnaris (Figs. 2 and 4). It is not advisable to mobilize the flexor carpi ulnaris, for this would allow it to bow somewhat radially. When the flexor carpi ulnaris is to be used as a motor or when it is non-functioning and thus would bow markedly to the radial side, the pulley can be constructed from part of this tendon as is shown in Figure 3. However we have found that insertion of the proximal end of the segment left attached to the pisiform bone into a drill hole in the very distal end of the ulna provided a larger pulley and thus one with less tendency toward adherence to the tendon passing through it. Furthermore, the pulley constructed in this fashion does not swing as much to the radial side as do others. A third method of construction of a pulley is to use a short free tendon graft as a loop, both ends of which are inserted into two drill holes approximately 1 centimeter apart, placed in the distal end of the ulna. This is particularly valuable when the flexor carpi ulnaris already has been used for transfer into the extensor tendons of the fingers or when it is contemplated that such a transfer will be carried out. In any instance, anastomoses of tendons should be placed well away from whatever type of pulley is used, the usually being accomplished with ease. It is obvious that the presence of such a pulley near a tendon juncture would increase the possibility of adherence at that point. When the extensor carpi ulnaris is employed as a motor, no pulley is necessary; the direction of pull of this tendon, after it has been rerouted, is toward the pisiform bone.

As noted earlier herein, we have on some occasions employed the Thompson procedure. We followed the technique originally described

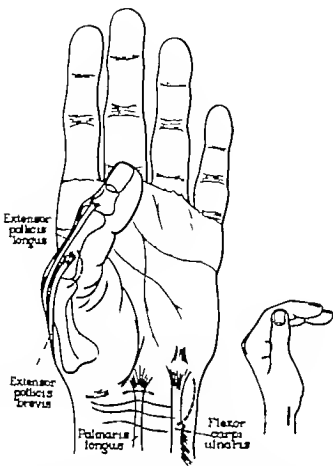


Fig. 5 Skin incisions (In dotted lines) for transfer of palmaris longus muscle as shown in Figure 2. In addition to those incisions shown, a small transverse incision over the palmaris longus muscle is made in the middle third of the forearm through which this tendon is withdrawn and resected toward the pialform bone.

from the base of the first metacarpal bone through the same incision. These measures usually allow the thumb to be placed passively in the desired position. If sufficient release of the thumb still is not obtained in certain cases some further benefit may be obtained by capsulotomy of the carpometacarpal joint. The results of this procedure, however generally are less satisfactory than are those of severance of the adductor pollicis muscle.

Some residual paresis of the long flexors of the fingers occasionally occurs among these individuals. Most commonly the flexor digitorum profundus muscle to the index finger and the flexor pollicis longus are involved. If it is felt that this residual paresis is permanent reinforcement of the function that is already present is indicated. The flexor digitorum profundus of the index finger usually can be joined to the remaining profundus mass; this

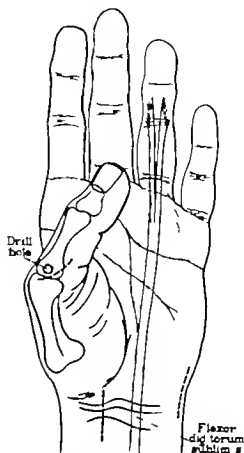


Fig. 6 Skin incisions (In dotted lines) for transfer of flexor digitorum sublimis of ring finger with direct insertion into the proximal phalanx as illustrated in Figure 4.

should be done in such a position that with the long finger fully extended the index finger will be flexed to 45 degrees in all joints. Depending on the available tendons the flexor pollicis longus muscle can be reinforced with the palmaris longus or with one of the sublimis tendons. Although the procedure is not an integral part of the opponens transplant, it will increase the strength of the thumb in opposition.

RESULTS

There are a total of 84 cases in this series representing the results obtained by several different surgeons who used a variety of procedures. Information is available as to the methods employed in 75 cases. Of the 75 patients 67 were observed or traced for sufficient time to allow adequate evaluation. The results were classified as excellent, satisfactory, and unsatisfactory.

Excellent signifies the ability actively to abduct the thumb 2 inches (5 cm) from the

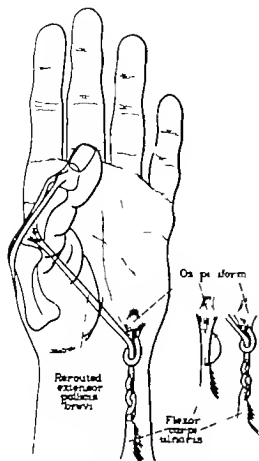


Fig. 3. Completed tendon transfer involving use of the flexor carpi ulnaris prolonged to the extensor pollicis brevis. Insert shows method of construction of pulley in such cases.

Department After a period of about 5 days gradual passive and active extension of the wrist is begun and after another 5 days the patient usually has begun to use the transfer in acceptable fashion. He is then allowed to discard the splint and to begin active use of the hand. The patient's movements are watched until it is assured that he is using the transplanted tendon well. A period of about 6 weeks after operation usually is required in order that the patient may become completely automatic in the use of the rerouted tendon for opposition.

In a few instances the patients have been slow in learning the use of the transferred tendons. In such instances it is wise to prolong the period in which the elastic splint is worn in order that the thumb may remain in a posi-

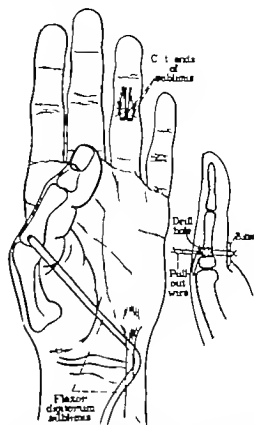


Fig. 4. Completed tendon transfer. The flexor digitorum sublimis of the ring finger is used, and is rerouted over the flexor carpi ulnaris and inserted into bone. Insert shows details of insertion of the tendon into the proximal phalanx of the thumb by means of pull-out wire.

tion of abduction, opposition and rotation, rather than fall back against the hand.

SUPPLEMENTARY PROCEDURES

In instances in which an adduction deformity of the thumb cannot be overcome by the previously described nonoperative means, the adductor contracture present generally can be corrected by division of the adductor pollicis muscle at its point of insertion. Exposure is procured by the making of a short longitudinal dorsal incision between the first and second metacarpal bones. Care should be taken to keep this incision as far proximal as possible, thereby precluding undue tension on the skin suture line when the thumb is placed in opposition and abduction postoperatively. If there seems to be any contracture of the first dorsal interosseous muscle it can be stripped

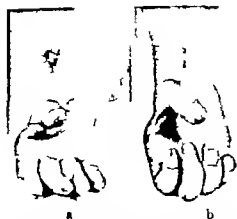


Fig 10. a and b, Excellent result obtained after a Bunnell type of transfer in which the flexor digitorum to the ring finger was utilized, with direct insertion into the proximal phalanx of the thumb in a patient with complete paralysis of all the intrinsic muscles of the hand



Fig 11

Fig 12

Fig 11 Excellent result obtained after a Bunnell type of transfer in which the palmaris longus muscle was utilized and was prolonged by the extensor pollicis brevis, in a patient with complete paralysis of all the intrinsic muscles of the hand.

Fig 12 Satisfactory result after transfer of the palmaris longus muscle as in Figure 11, in a patient with complete paralysis of the intrinsic muscles of the hand

used as motor power was the only one available. Therefore the incidence of the methods does not accurately reflect the choice of procedures in cases in which the injuries were uncomplicated

The question naturally arises as to the deficits resulting from transfer of the motor tendon. The rerouting of the palmaris longus muscle, of course, results in no loss of function. Similarly there is essentially no disability when the flexor carpi ulnaris or extensor carpi ulnaris is used. The function of a flexor digitorum sublimis when it is transferred is taken over by the flexor digitorum profundus in question to such an extent that its absence cannot be determined by clinical examination. In no instance has any patient felt that his finger was noticeably weakened by transfer of a flexor digitorum sublimis

ANALYSIS OF FAILURES

In this series there were as previously pointed out 12 cases in which the result was classified as unsatisfactory. An analysis of these cases is enlightening as to pitfalls to be avoided

In 2 instances the thumb was in good position 3 weeks postoperatively but returned to an adducted position during the ensuing 2 to 3 weeks and never showed active opposition. In both of these cases the operative sites were re explored. In the first instance the anastomosis between the palmaris longus and extensor pollicis brevis was found to have disrupted

The flexor digitorum sublimis to the fourth finger was then utilized as a motor it was inserted into the proximal phalanx of the thumb with an excellent result. In the second instance the short extensor had apparently disrupted from its insertion over the proximal phalanx probably because of excessive dissection. The flexor digitorum sublimis to the third finger (that to the fourth having been utilized in the previous procedure) was then used it was inserted into a drill hole with resulting excellent function. From the experience reflected in these 2 cases it should be concluded that re-exploration is indicated in cases in which the function of opposition and abduction is not manifested postoperatively



Fig 13 Palmar a and lateral b, a picture of a satisfactory result after a Thompson procedure. More opposition was possible than is shown here

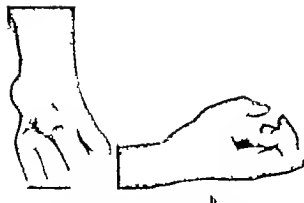


Fig. 7. Palmar, a, and lateral, b, view of excellent result after a Buennell type I transfer in which the flexor digitorum sublimis of the ring finger is utilized, the direct insertion in the distal end of the metacarpal bone in patient with complete paralysis of the intrinsic muscles.



Fig. 9. Lateral, a, and palmar, b, typical preoperative appearance of a hand in which there is complete paralysis of the intrinsic muscles but not of the long flexor muscles.

palm oppose it to the tip of the ring finger and to rotate it so that the plane of the nail is within 20 degrees of the plane of the palm. These are essentially those movements possible in a normally functioning hand. If the thumb was deficient in the slightest degree in any of the above criteria, the result was *not* considered excellent but only satisfactory.

In all cases in which movement of the thumb was rated satisfactory there was a decided

improvement in function and the patient was satisfied with his result.

In those cases in which there was no appreciable improvement over the preoperative condition function was rated 'unsatisfactory.'

In Figure 9 is illustrated the typical preoperative function in all the hands concerned in the present study.

Among the 67 cases in which function was evaluated it was classified as excellent in 7 (Figs. 10 and 11) and as satisfactory in 13 (Figs. 12 and 13). In 12 cases the result was judged to be failure. The data are summarized in Table I.

It is seen from examination of the data that every method is capable of giving a good result. In general the degree of success was directly proportional to the completeness of fulfillment of the prerequisites for transplant without regard for the method employed. As an example, in hands with fixed deformities of sufficient severity to necessitate severance of the adductor pollicis muscle, there were no excellent results. However, although the results in these cases were given only a satisfactory rating, the functional result considering the over-all condition of the hand actually was an excellent one in each case, and it was felt that maximal improvement had been obtained.

The variety of methods utilized in this series resulted from the fact that many of the injuries were of such nature that the muscle

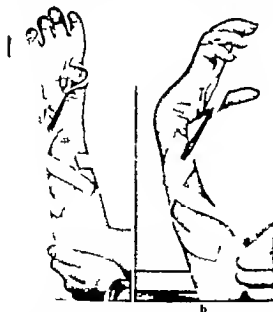


Fig. 8. Palmar, a, and lateral, b, aspects of an elastic splint employed after removal of sutures the twenty-first postoperative day.

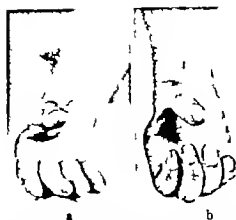


Fig. 10. a and b, Excellent result obtained after a Bunnell type of transfer in which the flexor digitorum to the ring finger was utilized, with direct insertion into the proximal phalanx of the thumb. In a patient with complete paralysis of all the intrinsic muscles of the hand.

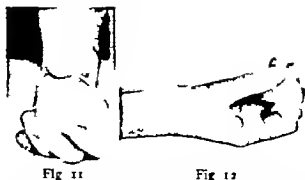


Fig. 11

Fig. 12

Fig. 11 Excellent result obtained after a Bunnell type of transfer in which the palmaris longus muscle was utilized and was prolonged by the extensor pollicis brevis in a patient with complete paralysis of all the intrinsic muscles of the hand.

Fig. 12 Satisfactory result after transfer of the palmaris longus muscle as in Figure 11 in a patient with complete paralysis of the intrinsic muscles of the hand.

used as motor power was the only one available. Therefore, the incidence of the methods does not accurately reflect the choice of procedures in cases in which the injuries were uncomplicated.

The question naturally arises as to the deficits resulting from transfer of the motor tendon. The rerouting of the palmaris longus muscle, of course, results in no loss of function. Similarly there is essentially no disability when the flexor carpi ulnaris or extensor carpi ulnaris is used. The function of a flexor digitorum sublimis when it is transferred is taken over by the flexor digitorum profundus in question to such an extent that its absence cannot be determined by clinical examination. In no instance has any patient felt that his finger was noticeably weakened by transfer of a flexor digitorum sublimis.

ANALYSIS OF FAILURES

In this series there were as previously pointed out 12 cases in which the result was classified as unsatisfactory. An analysis of these cases is enlightening as to pitfalls to be avoided.

In 2 instances the thumb was in good position 3 weeks postoperatively but returned to an adducted position during the ensuing 2 to 3 weeks and never showed active opposition. In both of these cases the operative sites were re-explored. In the first instance the anastomosis between the palmaris longus and extensor pollicis brevis was found to have disrupted.

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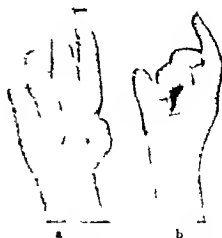


Fig. 13 Palmar a and lateral b aspect of a satisfactory result after a Thompson procedure. More opposition was possible than is shown here.

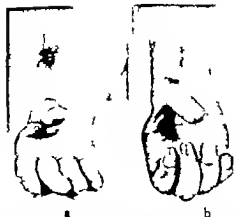


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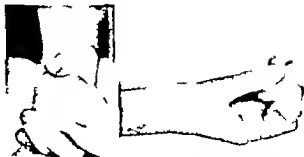


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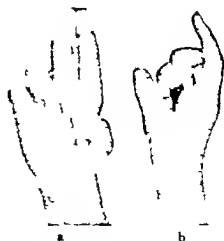


Fig. 13. Palmar a, and lateral b, a picture of a satisfactory result after a Thompson procedure. More opposition was possible than is shown here.

TABLE 1—RESULTS OF OPPONENS TRANSPLANT IN 75 CASES, ANALYZED ACCORDING TO TYPE OF PROCEDURE EMPLOYED*

Procedures, per	Result in evalua- tion of cases		Cases not eval- uated
	Facet best	Inter- tarsal	
Palmaris longus	2		
Prolonged b. extensor pollicis	2		
b. Prolonged with free graft			
Flexor carpi ulnaris			
Prolonged b. extensor pollicis			
b. Prolonged with free graft			
Flexor digitorum sublimis, fourth finger			
Prolonged with extensor pollicis			
b. Prolonged with free graft			
Extensor carpi ulnaris			
Prolonged with extensor pollicis			
b. Prolonged with free graft			
Flexor digitorum sublimis, with direct insertion	6	8	
Sublimis of ring finger	5	6	
b. Others			
Thompson method			
Sublimis of ring finger			
b. Sublimis of ring finger			
Total	20	14	61

*Except for the group entitled "Thompson method," the Bunnell type of procedure as employed and the designated tendon used as motor source.

†If additional cases no information was available as to the details of the procedure employed or the results obtained.

In 3 instances of failure the opponens transplant was but one part of a multiple-tendon transfer procedure. This resulted in compromise in the securing of correct tension and ideal position with ultimate failure. When other tendon transplant operations about the wrist are performed the opponens procedure usually will profit by being postponed to a later date. This in addition simplifies the problem of re-education for the patient.

In 2 cases the tension on the completed anastomosis was extremely slight, which may well explain the failure which occurred. Fixed deformities of parts of the hand other than the thumb were present in 2 cases, and were of such severity that they could not be overcome.

Operation for these individuals was ill-advised, and the resulting failure could be anticipated. In another instance because of an unfortunate oversight the motor utilized was a paralyzed muscle. In 2 cases the causes of failure were undetermined because the patients had been dismissed from the hospital and thus were not available for evaluation.

This analysis of the failures serves well to emphasize the prerequisites, since in many of the aforementioned instances they were not present and failure followed. We feel that in future cases there should be no instances of failure.

COMMENT AND CONCLUSIONS

A series of cases has been presented in which a variety of types of opponens transplant was carried out. The indications and prerequisites for this procedure have been discussed, and the technical details of importance have been related. An analysis of the series has been presented in an attempt to judge the end results. The failures have been discussed with a view to prevention of such poor results in future cases.

The over all study of this group of cases allows the formation of some conclusions as to the methods of choice to be employed. In the usual case it is probably preferable to use the Bunnell type of operation since the Thompson procedure, although satisfactory fails to give quite as much abduction as does the former type. In cases in which there is marked scarring about the volar surface of the wrist, the Thompson procedure is preferable in order that the operation may be carried out in normal tissue.

When the Bunnell method is employed it is probable that a good result can be obtained from the use of any source of motor power. In instances in which all possible sources of motor power are available in good strength, including a rather strong palmaris longus muscle, and cases in which the extensor pollicis brevis on surgical exploration is found to be sturdy and to give the desired action on the thumb, the use of these in the manner described (Fig. 2) is very satisfactory. If the palmaris longus is thin or weak however or if the short extensor of the thumb is attenuated or exerts a poor

action on the thumb it is probably wise not to employ this method but to use instead the flexor digitorum sublimis tendon to the ring finger severed within the digital sheath with direct insertion of it into the thumb in the manner described (Fig. 4). Furthermore, if there is some adduction deformity of the thumb and a strong motor source is desired such use of the flexor digitorum sublimis to the fourth finger is of even greater advantage.

In point of fact the use of this method has certain definite advantages over all others. It provides very strong motor power with excellent excursion. There is no anastomotic site to become adherent to surrounding structures. The insertion of the tendon into bone is so durable as to render disruption virtually

impossible. At present it would be our method of choice.

If these tendons are not available however a good result can be procured by carrying out an accurate procedure in which any of the methods discussed are employed. The important considerations are attention to the prerequisites for a good result and care as to the technical details of the operative procedure.

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TREATMENT OF PERSISTENT COLON BACILLUS INFECTIONS OF THE URINARY TRACT BY SULFASUXIDINE AND STREPTOMYCIN

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MODERN drug and antibiotic therapy has enabled us to eradicate a large percentage of the non surgical infections of the urinary tract in a manner which would have seemed almost miraculous a decade ago. There are however a number of patients both male and female who respond favorably to treatment for a short time but who suffer recurrence of infection shortly after therapy is discontinued. Still other patients do not achieve permanent urine sterilization by any previously employed combination of medical or instrumental treatment.

It is well to initiate this discussion by emphasizing the fact that the efficiency of modern urinary antiseptics should in no way moderate the absolute necessity for a thorough urological examination in each patient suffering from a urinary tract infection. The search for as well as the eradication of any extraordinary focus of infection remains as important today as it was heretofore. The correction of any lesion which causes obstruction to the free outflow of urine is of paramount importance before medical management can be permanently successful.

Our experience parallels that of most other observers in that we have found a predominance of the colon typhoid or coliform group of organisms as the main cause of urinary tract infection. In most individuals in whom there is no associated obstructive uropathy the urinary infection can be eradicated by the removal of systemic foci of infection and the administration of the proper urinary antiseptics. The ingestion of mandelic acid or sulfa

derivatives, or the alternate use of these drugs has been effective in a large percentage of our patients when the colon bacillus has been the principal infecting agent. Where coccal organisms are also present in the urine, penicillin is indicated in conjunction with sulfa or mandelic acid compounds. At times the older urinary antiseptics such as hexamethylenamine in its various forms, may prove effective in sterilizing the urine when our modern drugs have failed.

Herrold has recently suggested methods for *in vitro* tests of susceptibility to penicillin and streptomycin of the bacteria found in non-specific infections of the urinary tract. Tests of susceptibility by using exudates or smears enable a prompt grading and in addition, where mixed infections occur the relative susceptibility of the various organisms can be determined.

Wider clinical application of these principles may enable us to determine more quickly which medication is most applicable for the patient at hand. Despite our increased success in the treatment of colon bacillus infections of the urinary tract with the newer antiseptics and antibiotics, we continue to encounter individuals in whom we have eliminated all extraordinary foci and in whom we have repeatedly demonstrated that there is no obstructive uropathy but where we have been unable to clear the urine permanently of the infecting organisms by varied medication.

The question naturally arises: Why do these individuals continue to have recurrences? Is it because they are infected with an unusually virulent strain of bacteria or do they continue to have a systemic focus of infection which reinflects the urinary tract?

Kauffman of Copenhagen has shown that certain strains of colon bacilli are recognized

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important etiological agents in infections of the urinary and bile tracts and particularly in producing appendicitis. While we have all agreed that the transfer of organisms from the large bowel to the urinary tract can and does frequently occur, clinical proof of this is often difficult or impossible. Our interest in further attempting to limit the colon bacillus content of the large bowel by sulfasuxidine was stimulated by the report of Everett Scott and Steptoe who described the successful use of this drug in the treatment of acute pyelitis of pregnancy due to the colon bacillus in pure or mixed culture.

Our recent associate, Dr. Robert McAllister, began the treatment of a group of patients with resistant urinary tract infections by giving sulfathaladine and later sulfasuxidine as the sole medication. From 8 to 10 grams of the drug were given daily for the first 2 weeks and then 4 to 5 grams daily for an indeterminate period of from 8 weeks to 10 months. In general this selected group of patients responded favorably to this treatment. The urinary symptoms were reduced, constipation was often completely relieved and the pyuria was diminished. These patients experienced enough improvement to be willing to continue the therapy. Despite the prolonged ingestion of sulfasuxidine they were remarkably free of toxic symptoms. One woman complained of dizziness and anorexia and these symptoms subsided promptly with discontinuance of the drug. Patients may be sensitive to sulfasuxidine but Bergen found the toxic reactions of sufficient severity to indicate discontinuance of the drug in only 1 per cent of 2000 patients. Roth reported an occasional skin eruption or febrile reaction in patients sensitive to sulfathiazole. Hematuria and crystalluria in one patient were reported by Clay and Pickrell. In 1943 Johnson reported a fatal instance of agranulocytosis apparently due to sulfasuxidine. None of these complications developed in our patients. Despite the clinical improvement sustained during this therapy the colon bacilli persisted in the urine or recurred shortly after discontinuing treatment.

Sulfasuxidine is the trade name for succinylsulfathiazole. About 5 per cent of the drug is said to be excreted in the urine as sulfathia-

zole. Roth and his associates reported a blood level of free sulfathiazole rarely above 15 milligrams per cent in patients taking 25 gram per kilogram weight in six divided doses every 24 hours. Extensive studies have proved that both sulfasuxidine and sulfathiazole are sparingly absorbed from the bowel and have their action limited largely to the gastrointestinal tract. Roth has stated the amount of drug required to alter the intestinal flora will be determined by the content of the bowel, its mucosal surface area and the rate at which the drug passes over the surface rather than by the weight of the patient. The coliform bacilli in the feces is reduced to less than 1000 organisms per gram of wet stool when 30 grams of sulfasuxidine is given by mouth every 4 hours to adults in the following times: (1) 37 per cent in 3 days of therapy, (2) 80 per cent within 5 days and (3) 94 per cent within seven days. The stools become semifluid, smaller in bulk, relatively odorless and there may be three to four movements a day. A voluminous literature with many detailed case reports verify the value of this drug in the preparation of the bowel for extensive surgical procedures.

During the course of the above study a few grams of streptomycin became available to us for experimental purposes. Because of the extreme resistance of a colon bacillus infection in the only remaining kidney of a man 60 years of age who had previously received all manner of modern treatment and who had been on sulfasuxidine with slight improvement for 3 months a total of 5 grams of streptomycin were administered to him over a period of 6 days. The urine rapidly cleared to complete in 3 days with negative cultures after the fifth day. This patient was continued on 4 grams of sulfasuxidine daily for 4 months after leaving the hospital. It is now 16 months since the urine has shown pus or bacteria. The apparent complete cure of this most resistant infection by combined sulfasuxidine and streptomycin administration has prompted us to use this combination in a series of 23 patients. All of these patients had been under observation for from 3 months to 20 years without an effective or lasting eradication of the colon bacillus from the urine. The results obtained

have been so uniformly successful, and so much more noteworthy than when streptomycin alone was employed that we feel this combination offers the possibility of an effective method of cure in a greater percentage of these resistant cases than has been obtained by other methods of medication heretofore employed.

In attempting to explain the reason for urine sterilization in these patients, in whom all previous methods had failed the question naturally arises as to whether or not this combined medication has succeeded because it has lessened the colon bacillus transfer from the bowel to the urinary tract and thus permitted the natural immunity of the individual to complete the eradication of the infection.

Reports, which are daily becoming more frequent of the results one may expect to obtain by the administration of streptomycin for colon bacillus infection of the urinary tract suggest a favorable response in 45 per cent to 60 per cent. The committee on chemotherapeutics (Keefer and associates) reported a 52 per cent recovery in 154 patients with *Escherichia coli* infection of the urine 25 per cent improved and 21 per cent not affected. Of the patients that improved 19 per cent relapsed after treatment was stopped. Nearly all the relapses occurred in one week. Findlay reported the failure of streptomycin in 5 of 6 cases of *Bacillus coli* infection of the urinary tract. He explained the failure as being due to the rapid development of extreme resistance to the antibiotic.

The favorable response in our patients has been approximately 85 per cent. That the streptomycin alone has not been the conclusive factor seems demonstrated by the fact that those of our patients who could not tolerate the continued ingestion of sulfasuxidine had a relapse of urinary infection. This relapse occurred in 2 of our patients.

CASE REPORTS

Mrs. J. K. age 60 years, gave a history of intermittent attacks of chills, fever and pyuria for a period of 35 years. Urine cultures showed a heavy growth of *Escherichia coli*. The pyelographic studies were negative for obstructive uropathy. All types of urinary antiseptics had been administered. On a few occasions the urine cleared of pus but negative cul-

tures were never reported. On May 20, 1946, patient entered Wesley Memorial Hospital. Ten million units of streptomycin were administered. Cultures of the urine were reported as negative May 26. Two days before leaving the hospital the patient developed an intolerance for the sulfasuxidine and refused to take further dosage of the drug. Subsequent cultures taken at the office were reported as follows: June 12, 1946, negative after 48 hours; July 23, 1946, negative after 48 hours; August 2, 1946, negative after 48 hours; December 14, 1946, *Bacillus coli*; January 13, 1947, *Bacillus coli*; May 15, 1947, *Bacillus coli*.

Mrs. O. W. age 48 years, gave a history of "chronic cystitis." All manner of urinary antiseptics had been tried but cultures were always positive for colon bacilli. This patient entered Wesley Memorial Hospital on May 23, 1946. The urine showed *Escherichia coli* 5 million units of streptomycin was administered. Cultures of the urine were reported on June 3 and 8. The sulfasuxidine had to be discontinued because her referring doctor was not interfered with the patient's ulcer management and aggravated the ulcer pain. Subsequent cultures from the office were reported as follows: July 4, 1946, *Bacillus coli*; August 26, 1946, negative; October 4, 1946, negative; November 6, 1946, *Bacillus coli*; November 18, 1946, *Bacillus coli*; May 14, 1947, *Bacillus coli*.

We were unable to obtain negative cultures at any time in 2 of our 23 patients.

Mrs. L. W. age 65 years, gave a history of a right nephrectomy in 1932 for a calculeous prostatic. In December 1944, a left nephrostomy with pyeloplasty was performed for a pyohydronephrosis. There was good visualization of kidney and emptying of the pelvis and bladder. Sulfasuxidine (4 grams daily) was administered for 8 months before the first 5 million units of streptomycin were given. The urine became clear but remained positive for *Escherichia coli*. A second course of streptomycin (10 million units) was prescribed but the cultures remained positive. Following the streptomycin the patient developed dizziness and inco-ordination. Nine months have passed since the streptomycin was given. The dizziness had completely disappeared. A culture on May 17, 1947 was positive for *Bacillus coli*. Urine showed 10 to 20 pus cells per high-power field.

The second case that failed to show negative cultures at any time on combined sulfasuxidine and streptomycin therapy was that of Mrs. H. G. age 34 years.

Retrograde and intravenous pyelograms showed a hypoplasia of the right kidney. We believe the function of this kidney was too poor to concentrate the streptomycin in sufficient quantity to inhibit bacterial growth. A nephrectomy is probably indicated.

TABLE I.—SUMMARY OF 23 CASES

Case No.	Culture	Salmonella before hospitalization for S. dysenteriae	Graves of atrophic gastritis	Salmonella after leaving hospital	Date of admission to hospital	Date of bacteriologic therapy	Case No.	Date of report of first neg. culture	Subsequent cultures	Age of patient, sex	Previous surgery (G.)	Duration of recurrent attack	Comments
L. W.	Each col.	+	7	4 daily	3-12-04b 9-17-04b	3-10-04b 9-17-04b		Always positive	Positive Each col.	6½ y	015-Calculus pyrocephalus 044 Left laparotomy	8 yrs.	Recurrence May 047
E. K.	Each col.	+	5	None	3-30-04b	3-30-04b		3-6-04b	Positive 3-3-04b	60 y	None	33 yrs.	1st recurrence April 047
E. D.	Each col.	+	5	4 daily	4-9-04b	4-30-04b	3	4-30-04b	Negative	44 y	None	3 yrs.	Neg. May 1947
P. M. G.	Each col.	+	5	4 daily	4-13-04b	5-3-04b	4	5-3-04b	Negative	43 y	None	3 yrs.	Neg. May 047
E. J. L.	Each col.	+	5	4 daily	5-8-04b	5-14-04b	5	5-14-04b	Negative	50 y	None	4 yrs.	Neg. May 047
W. C. O.	Each col.	+	5	4 daily	5-18-04b	5-30-04b	6	5-30-04b	Negative	6 y	None	37	Neg. May 047
O. W.	Each col.	+	5	None	5-13-04b	5-3-04b	7	5-3-04b	Positive 7-8-04b Negative 7-8-04b	18 y	045 Curcuma	1-3 yrs.	Neg. Apr. 1947
R. T. J.	Each col.	+	5	4 daily	5-14-04b	5-14-04b	8	5-14-04b	Negative	31	04 Left laparotomy	5 yrs.	Neg. Apr. 047
O. J. L.	Each col.	+	5	4 daily	5-14-04b	9-6-04b	9	9-6-04b	Negative	56 y	None	37	Neg. Apr. 047
M. C.	Each col.	+	5	4 daily	9-6-04b	9-6-04b		9-6-04b	Negative	65 y	None	3 yrs.	Neg. Apr. 047
A. N.	B. coli	+	5	4 daily	9-30-04b	9-30-04b		9-3-04b	Negative	63 y	None	37	Neg. check up
R. T.	Each col.	+	5	4 daily	9-7-04b	9-7-04b		9-30-04b	Negative	43	None	6 years	N. check up
B. S.	Each col.	+	5	4 daily	9-26-04b	9-26-04b	3	9-3-04b	Negative	41	044 T. U. R. 045 T. U. R.	3 yrs.	Neg. May 047
M. J.	Each col.	+	5	4 daily	9-30-04b	0-3-04b	14	0-0-04b	Negative	41	None	37	Neg. May 047
P. E. G.	B. coli	+	5	3 daily	0-18-04b	0-18-04b	5	0-12-04b	Negative	60	04 T. U. R. 044 T. U. R.	6 yrs.	Neg. May 047
M. A.	B. coli	+	5	None	3-04b	3-04b	6	9-10-04b	Negative	62	040 Constipation of Cn bladder	5 yrs.	Neg. May 047
B. P.	Each col.	+	5	4 daily	3-2-04b	4-04b	7	9-10-04b	Negative	41	040 Constipation of polypoid vesical neck	24 yrs.	Neg. May 047
P. H.	Acrobacter aerogenes	+	5	4 daily	30-04b	30-04b	18	10-04b	Negative	50	042 carcinoma of bladder complicated, 043 Bladder Trans-plantation of ureter	5 yrs.	Neg. May 1947
L. K.	Each col.	+	5	3 daily	3-15-04b	14-194b	9	27-04b	Negative	44	None	3 yrs.	Neg. Apr. 047
T. T.	Each col.	+	5	4 daily	3-2-04b	3-2-04b	20	3-8-04b	Negative	60	044 Prostatectomy left ureterolithiasis 045 Left laparotomy	1-3 yrs.	Neg. May 047
H. G.	B. coli	+	5	4 daily	8-10-04b	12-04b		Positive Each col. Negative 3-10-04b	Each col. 3-10-04b	44 y	None	18 yrs.	Hypodermic right kidney
R. K.	B. coli	+	5	4 daily	3-10-04b	3-04b		27-04b	Negative	41	040 T. U. R. 043 T. U. R.	7 yrs.	Neg. M. y 047
A. O.	B. coli	+	5	4 daily	10-04b	10-04b	3	10-04b	Negative	41	None	37	Neg. May 1947

T. U. R. transurethral resection.

To the present time 19 of our 23 patients have sterile urine. In none of these cases was more than 5 grams of streptomycin administered. Sulfasuxidine was given before, during and following the administration of the antibiotic.

The following brief case histories illustrate the type of patient so treated.

R J, age 58 years, white male gave a history of pyuria of 15 years duration. In 1943 a left nephrolithotomy was performed. Urine cultures have been persistently positive for *Bacillus coli* in spite of the liberal administration of penicillin, sulfonamides, mandelic acid, urotropin and mandelamine. Retrograde pyelograms showed a left middle hydrocalyx. A negative urine culture was obtained after 3 million units of streptomycin had been given. A total of 5 million units were administered. Urine cultures have been taken at 2 to 4 week intervals and all have been negative for growth. The patient left the hospital on May 24, 1946. He continued to take 4 grams of sulfasuxidine daily without toxic effects for 5 months. April 18, 1947 urine cultures were negative.

B S, age 50 years. This patient had two transurethral resections of the vesical neck in 1943 and a third in 1945. Intravenous pyelograms showed normal outlines. Urine cultures were positive for *Bacillus coli*. After a preliminary course of sulfasuxidine this patient entered Wesley on September 16, 1946 for a course of 5 grams of streptomycin. Urine cultures were sterile on the 18th and 20th. All subsequent cultures have been negative. About 3 months ago the patient discontinued the sulfasuxidine of his own volition because he thought it was becoming toxic to him. The last culture on May 15, 1947 was negative. The urine is clear, free of pus and the patient is well in every respect.

F G., age 66 years. This patient, like the one just reported, had had three transurethral prostatic resections the first in 1941, second in 1944, and third in 1945. Symptoms of nocturia, frequency and burning persisted because of a chronic cystitis due to *Bacillus coli* infection. The severity of the symptoms was modified by the use of sulfasuxidine. On October 18, 1946 the patient entered Wesley Memorial Hospital. A negative urine culture was obtained after the administration of 4 grams of streptomycin. The urine is negative to the present time. The patient has taken 3 grams of sulfasuxidine daily for 7 months.

P H., age 56 years. Five years ago a papillary carcinoma of the bladder was coagulated transurethrally. In February of 1943 the left ureter was transplanted into the bladder because of a stricture of the orifice. The urine has been cloudy with pus. Urine cultures showed a heavy growth of *Aerobacter aerogenes*. On November 21, 1946 the patient entered Wesley Memorial Hospital. A cystoscopic study showed a slight enlargement of the median and left lateral lobes of the prostate. A retrograde pyelo-

ureterogram showed a grade II left hydronephrosis. Five million units of streptomycin were given. Urine cultures were reported as negative on November 21. The pus count was 2 to 4 cells per high-power field as compared with numerous cells on admission. Subsequent cultures have been negative. The patient continued to take 4 grams of sulfasuxidine daily for 6 months. Cultures on June 10, 1947 were negative.

Fifteen female and 8 male patients varying in age from 73 to 23 years have been studied in detail. Each of these patients had an unusually resistant urinary infection, 22 with positive urine cultures for *Escherichia coli* and one with *Aerobacter aerogenes*. Obstructive lesions in the urinary tract were ruled out in each patient by complete investigation. The duration of recurrent urinary infection ranged from 33 years to 1 year. The average time for the entire group was 8 years. Ten of these 23 patients had had surgical operations upon the urinary tract.

It is now 17 months since the first patient was placed upon the combined therapy of sulfasuxidine and streptomycin (Case 1). His urine has remained negative to culture and free of pus for this time. Prior to this treatment his urine had been constantly infected for a period of 5 years. Two patients have had sterile urine for 14 months, 2 for 12 months, 2 for 9 months, 6 for 8 months, 1 for 7 months, 4 for 6 months and 2 for 4 months.

CONCLUSION

We are of the opinion that this series of patients, although small in number, suggests an unusual efficacy in the combined administration of sulfasuxidine and streptomycin in otherwise resistant bacillary infections of the urinary tract.

Of 23 patients so treated 19 have maintained a completely favorable response for periods sufficiently prolonged to suggest the probability of permanent cure. As previously described in detail these patients received sulfasuxidine for varying periods before, during and after the administration of 5 to 17 grams of streptomycin.

Sulfasuxidine or streptomycin given alone has not had the favorable effect observed in the combined therapy. Success in the 19 patients with long standing resistant infection

seemed dependent upon the patients ability to continue the ingestion of sulfasuxidine. Fortunately the toxicity of sulfasuxidine is low and the drug can be given in large doses for long periods of time.

Toxic symptoms if they occur subside rapidly when the drug is discontinued.

This study is reported in detail in the hope that it will encourage a more widespread trial of this, or some similar combined therapy in

the treatment of otherwise resistant urinary infections of bacillary origin.

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THE RADICAL TREATMENT OF BRAIN ABSCESS

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BRAIN abscess is generally considered to be one of the most serious pathological conditions of the central nervous system the treatment of which is difficult and the prognosis doubtful. It seems however that such a pessimistic view is unfounded and its existence best explained by the consequences of the mistakes physicians often commit in not distinguishing between the two different stages of one and the same disease e.g. between the purulent encephalitis and the abscess proper. Consequently operative treatment which is indicated for an abscess, is applied when the suppurative process has still not been localized, that is when there is no indication for surgical intervention. It is difficult indeed to treat an abscess before it has formed.

Success in the treatment of cerebral abscess depends principally upon the moment surgical intervention is applied. The excellent and up to now unparalleled results obtained by MacEwen who from his 19 patients suffering from cerebral and cerebellar abscesses lost only 1 were chiefly due to the fact that he never used drainage in an acute stage of the disease but waited for proper encapsulation of the abscess.¹ He was no doubt, entitled to say that an uncomplicated brain abscess may be regarded as the most hopeful of all cerebral affections.

According to Adson and Craig it took us many years to learn that hasty emergency operations were futile and were accompanied by high mortality. This, undoubtedly was due to the insistence of colleagues that we do something as soon as a diagnosis of cerebral abscess has been made.

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According to F. y. Ambroise Paré reported in 1668 series of cases of abscess of the brain with remarkably low operative mortality. This was mainly due to the fact that he waited for localization and encapsulation of the abscess before operating. He first trepanned the skull over the lesion and 3 days later incised the dura mater allowing the brain to bulge forth. For drainage he used lead cannulas.

We must then define the term abscess, in order to find a reason for the somewhat unsuccessful results obtained in the treatment of cerebral abscesses. Experience shows that these are due not so much to mistakes in diagnosis or localization of the lesion as to the improper time chosen for operation. "No experienced surgeon would consider incising and draining an abscess in any other area of the body before encapsulation was completed" (18). Why then do so many surgeons behave differently in a case of cerebral abscess?

An abscess is, according to Lecture "a collection of pus in a new formed cavity distinctly limited from the surrounding tissue and which represents the end-result of an acute inflammatory process." The accent lies here on the statement that the abscess is the "end-result of an acute inflammatory process and that it is distinctly separated from the surrounding tissue."

"The reaction of the brain to focal purulent infection resembles the reaction of the other organs of the body to such a process in that there is rapidly formed a mesoblastic barrier about the bacterial focus. That is, of course, assuming the infection can be limited at all" (41). An abscess is the result of a protective process which is advantageous to the body and testifies to its resistance to the pathogenic organisms. If on the other hand, the virulence of the organisms is too great or the resistance of the body too weak no abscess will develop and the local inflammation of the brain will change into an encephalitis spreading over one or even both cerebral hemispheres.

The first fibroblasts, that is, the first signs of a capsule, appear around the liquefying focus of inflammation at the end of the first week, the capsule becoming mature and offering firm elastic resistance to the exploring brain needle only at the end of the second or even the third week (17, 21, 41). The development of a firm capsule requires a somewhat longer time in the case of an abscess of the

brain than in similar lesions located elsewhere in the body, probably because the brain contains less connective tissue and it is connective tissue which is the decisive element in any encapsulation. Actually Huguenin missed the capsule in an abscess of 32 days' duration and in another of 53 days' duration the capsule was still very thin. He found a thick elastic capsule only in a case of a brain abscess which had lasted for 83 days. Bergmann (6) states that Meyer examined the formation of the capsule in 21 cases of posttraumatic cerebral abscesses and came to the conclusion that the first signs of encapsulation appear 19, 20 and 25 days after the infection; the capsule becoming firm only in the sixth week of the disease. According to McKenzie a cerebral abscess is well encapsulated 4 to 5 weeks after the infection. Grant found that in the first 2 weeks of the disease only 3 out of 13 abscesses were encapsulated; between the third and fourth week 10 out of 18 already had a well developed capsule, and after 6 weeks all abscesses were definitely and distinctly walled off. Groff asserts that the resistance of the capsule to the exploring needle is well marked at the end of the third week after infection and Kahn states that he observed a patient in whom an abscess of 10 days' duration was already well encapsulated.

It is obvious therefore that the time necessary for the development of a capsule varies in each case, this fact being most probably due to a number of circumstances such as individual differences in the virulence of the organisms, method of invasion, degree of resistance of the body, etc.

However, it may be that one should not expect a cerebral abscess to be well encapsulated before the end of the third week after the infection and that before that time there is little hope for surgical intervention to end successfully. According to Grant who studied in detail the relationship between the success of the treatment and the duration of the disease the mortality in 30 cases of encapsulated abscesses was 33.3 per cent, while in the 19 cases of unencapsulated abscesses it reached 100 per cent. The best operative results were obtained when the patients were treated 4 to 6 weeks after the infection. If a patient dies

before the abscess is properly encapsulated that is before the proper time for operation is reached, the reason lies not in the postponement of surgical intervention, which at that time could only have been harmful but in the absence of sufficient resistance of the body to the infection. The rupture of a well encapsulated abscess rarely occurs more often the patients die because of an operation performed too early than because of surgical intervention applied too late. Out of 49 patients of Grant only 2 died because operation was delayed too long but 14 died because it was performed too soon.

There is now indeed no divergence of opinion as to the fact that operation for a cerebral abscess before capsule formation has taken place is nearly always fatal, yet the choice of the preferable procedure is still a much debated question. The treatment indicated is always surgical because although there are undoubtedly cases of brain abscess which come to self healing such an occurrence is very rare and the disease not properly treated ends sooner or later in death of the patient.

Without entering here any details of the history of the surgical procedures which have been and are still carried out in the treatment of cerebral abscess it is sufficient to say that the following are the most frequently used: (1) single or repeated tapplings of the abscess with emptying of its contents and with or without the introduction of penicillin into the abscess cavity; (2) drainage of the abscess; (3) extirpation of the abscess either intact or after evacuation of its contents. This last method of treatment seems to us to be the most rational but it has up to now been used by the majority of surgeons rather reluctantly. It is difficult to perceive the advantage of tapping or draining an encapsulated abscess over its removal *in toto*. On the contrary, it seems that there are many reasons why the last procedure should be the method of choice. It is as safe for the patient as the others and when crowned with success cures the patient more quickly and finally. Indeed it is difficult to understand why the removal of the overlying cortex and the upper dome of the capsule with consequent fungus formation as practiced by King (24) Kahn and others, should be safer

and less damaging than the removal of the abscess intact. Undoubtedly it is possible that a latent inflammatory process may sometimes persist around an abscess and be reactivated even by the most careful handling of the brain tissue. Such a complication however may follow any other surgical procedure as well. In fact this is a frequent consequence of drainage so much so that Coleman (10) is of the opinion that this phase of the treatment is still unsatisfactory and that there are inherent risks attending drainage of any kind. Usually, the brain resists such a reactivation of the inflammatory process, having already demonstrated its powers of resistance in limiting and encapsulating the primary focus.

It is certainly true that penicillin introduced into the abscess cavity through a small burr hole—a very simple procedure, may sometimes sterilize the abscess and consequently cause the capsule to shrink. Yet to leave the capsule *in situ* is equal to leaving in the brain a connective tissue scar which contracting must finally cause epilepsy. There is surprisingly little known about this complication of cured cerebral abscesses although one would *a priori* expect epileptic seizures to be a rather frequent sequel of nonradically treated abscesses. Dandy (12) the originator of the method of aspiration of brain abscesses states that in a few of his patients thus treated epilepsy developed 2 or 3 years later necessitating the resection of the part or the whole of a cerebral lobe containing the scar of the old abscess. Adson and Craig complain that epilepsy develops too often following abscess and that is why they are gradually becoming convinced that secondary operations, scar resections, as practiced by Penfield are indicated in selected cases a year or later following the initial operation. Penfield and Erickson (42) noted that 8 patients out of a group of 33 who recovered from cerebral abscess have had seizures after operation. In other words 24 per cent of their patients developed epileptic seizures due to the cicatrix left by the drainage or evacuation of a brain abscess. The patients were all traced for only 1 year or more and the authors presume that a longer period of follow up would undoubtedly result in a larger percentage.

Last but not least, recovery after the radical removal of a brain abscess comes on faster than after its drainage. In the first instance the convalescence lasts weeks, in the second sometimes several months. Finally it may be emphasized—and this is the result not only of our own observations but also of those of many others—that the evacuation of a brain abscess although it is large and situated deep in the white matter damages the brain surprisingly little. In all events, it is by no means more harmful than removal of a large meningioma or other benign brain tumor. The signs and symptoms which are sometimes many, accompanying brain abscess usually subside completely showing that often the clinical picture is produced chiefly by concomitant brain edema, toxicity of the pus, etc. However, the radical treatment although theoretically commended by many was up to now applied only by a few.

Busch advocated the removal of the capsule but only after its incision and the evacuation of the pus, adding that in certain circumstances this procedure is rather simple. Ballance is of the opinion that the treatment of encapsulated cerebral abscesses should consist of their radical removal. He cites however no observations in which this postulate has been realized. Bergmann (6) notes that if during the drainage of an abscess "its membranous wall is forced into the brain incision it should be seized and removed. However it was Kronlein who first removed a brain abscess *in toto*. He performed this operation on a woman aged 38 years, who developed Jacksonian epilepsy 5 years after a skull injury. At the operation a subcortical abscess, the size of an egg was found in the left frontal region. The author stresses the fact that such a radical removal of an abscess, which incidentally was diagnosed as brain tumor presents "a rarity in the literature concerning the subject. Krause states that chronic abscesses should be evacuated and the capsule removed, and Rawling states that since the drainage of an abscess seldom permits a permanent cure, the abscess filling up again as soon as the tube is withdrawn "it is generally advisable to attempt the entire removal of the abscess wall. As a rule there is no great difficulty attendant

in this process and the haemorrhage is seldom severe. According to Oppenheim (40) Bil

eter removed a brain abscess *in toto*. Bagley

discussing his 21 cases of cerebral abscess

mentions one in which the lesion was diagnosed as brain tumor and removed radically.

The patient recovered yet the author considers that we should not be led to practice this method which entails the removal of the protective membrane and exposes the brain to

any organisms and may result in a diffuse encephalitis. Sargent has had 5 cases of total

removal of posttraumatic cerebral abscess diagnosed properly before the operation. Bal

lado and Franke, although they are of the opinion that the best treatment of brain abscess

is its total removal assert that this ideal is only rarely realized. They say that the capsule of an abscess consists of not one but of

several layers which do not represent the true limits of the inflammatory process. Coleman

(12) writes that although in rare cases an abscess was successfully removed with its capsule

of rupture during removal appear too great to allow this to be a premeditated method of

dealing with brain abscess. The attitude of the author toward the radical removal of cerebral abscesses is therefore, negative in spite

of the fact that, as he states, a recurrence is a possibility in all methods except

perhaps where the entire capsule is removed. In 1946 he apparently changed his opinion as

he states that 'there is a good deal to be said for the radical extirpation with the capsule

in multiple abscesses or in those in which a large granulomatous mass forms which cannot

be eradicated. Adson and Craig consider that 'when it is possible to remove the abscess

and capsule without opening it this hastens recovery'. Adson in fact removed a brain

abscess without being aware that he had done so until the mass was opened after operation.

The wound healed by primary intention and the patient recovered fully. They say how

ever that our experience with removal of capsule following evacuation of the pus has

not been satisfactory since a secondary suppurative encephalitis develops that is more

troublesome to treat than the original infection.

The publication of Clovis Vincent in 1936 was an important milestone on the road leading to the more frequent use of the radical

treatment of cerebral abscess (51). His method of dealing with those lesions is as follows. If

there is a necessity for surgical intervention in an early stage (only however after 3 weeks

since the beginning of infection) on account of the severity of the patient's condition while

the abscess is not sufficiently encapsulated to be dealt with radically it should be localized

precisely by means of ventriculography and then the brain decompressed by a large osteo-

plastic flap turned down over the site of the lesion. After the aspiration of the pus the

bone flap is replaced without the dura being opened. The aspiration may be repeated

Once the abscess is firmly walled off it is dissected out intact. Applying this method in

3 cases of so-called subacute brain abscess Vincent obtained complete recovery in all of

them. In 2 other cases the abscess was removed *in toto* during the first operation with

out the brain being decompressed and the abscess aspirated. His assistants Puech, Tho-

mas and Brun (45) and Puech, Mahondeau and Askenazy (44) published their own ob-

servations of cases in which the abscess was also removed intact. In the second of those

2 cases the abscess was extirpated from the cerebellum a unique experience up to that

time. Vincent and his coworkers have had therefore 6 recoveries in 7 consecutive brain

abscesses. In all 7 patients the lesion was diagnosed properly before the operation and

the method of treatment applied with premeditation.

Cairns points out that in some chronic abscesses the capsule is so thick that the abscess

must be removed intact like a tumor. In others the abscess is loculated to such an extent that

thorough drainage is impossible and excision is the only treatment. In yet others there are

two or three separate though continuous chronic abscesses.

Lehman mentions only that radical removal of the brain abscess is feasible only in cases of old abscesses with a

strong capsule and thick contents. Yaskin Grant and Groff (56) at a meeting of the Neurological Society in Philadelphia presented 2 cases in which the abscess diagnosed

as brain tumor was successfully removed. In the discussion Grant said that he found it feasible to give the abscess a chance to form and coalesce and then to shell out the whole mass. He thinks that if the abscess is encapsulated one can do almost anything with it. Dandy's (13) ideas on the subject are different. He states dogmatically that one would suppose that because the abscesses undergo a firm encapsulation they are suitable for enucleation with a finger like some of the brain tumors. Attempts to do so are almost always harmful. The infection which is present in the capsule is still active and it can be easily awakened. A diffuse encephalitis and a wound infection is then unavoidable. I have seen only once an abscess successfully removed. Stich and Bauer believe that only seldom there is any need for removal of an abscess as in the majority of cases repeated aspirations are sufficient. Odom and Elvidge relate a very interesting experience of complete extracapsular removal of two abscesses resulting from infection of the brain by the *Bacillus typhosus*. Northfield strongly advocates enucleation as the proper method in dealing with brain abscesses. In his experience only 1 patient died out of 8 in whom enucleation was carried out. According to him the criteria to guide one as to when to enucleate the abscess are as follows: the subsidence of acute inflammation and the formation of a tough wall. However if the operation is unduly postponed it becomes technically more difficult owing to the formation of an excessive degree of scarring around the abscess leading to an unnecessarily wide excision of tissue. Secondary loculi or separate deeply placed abscesses may develop if a case is left too long. The third month i.e. between 8 and 12 weeks appears to be the time of election for enucleation. Nowicki extirpated radically 8 abscesses of the brain. In 6 cases he obtained good results. In one instance the patient died after the operation from meningitis and in another the patient was taken home soon after the operation in a serious condition and nothing is known about his later fate. Ferens mentions that he removed a brain abscess successfully. Pennybacker reviews the experiences of the Nuffield Depart-

ment of Surgery in Oxford, and analyzes the results of 50 consecutive cases of cerebral abscess. Whereas in the 21 cases in which simple aspiration, tube drainage, open drainage (Finckh method) and aspiration plus decompression were performed there were 13 fatalities, of the 26 cases in which the abscess was excised only 2 patients died. Primary extirpation was carried out in 7 cases, extirpation after aspirations in 11, extirpation after aspirations and decompression in 8 cases. One patient who died had multiple bronchogenic abscesses in both hemispheres and the other developed a fatal meningitis after primary extirpation of an abscess due to mastoid infection. In conclusion Pennybacker states that "we think this method is applicable in most cases and we feel more confident about a lesion dealt with in this manner than in any other because the infective area has been removed from the brain. There is no chronic or quiescent cavity left which may light up in the months or years to come and cause further trouble. Webster, Schneider and Lofstrom extirpated completely an encapsulated posttraumatic abscess obtaining primary wound healing. Kahn admits that "it is now an accepted fact, that the better encapsulated an abscess the easier its successful drainage or excision." It seems however that actually he does not remove them, even when the abscess has such a thick capsule that its upper pole must be excised before a thorough drainage is instituted.

Sachs reviewing his experiences with brain abscesses 6 of which were excised *in toto* and cured says that no unencapsulated abscess should be drained and that during the acute stage penicillin is an invaluable aid in bringing about encapsulation. Aspiration except in cerebellar abscesses should be used only as a palliative procedure until more radical treatment can be instituted. In conclusion he states that excision without drainage is the ideal procedure although he adds that "frequently marsupialization must be resorted to if in the course of an excision the abscess has been ruptured. According to Fincher who reports his 5 cases of abscess (1 cerebellar) cured by removal *in toto*. The results thus far have been such as to suggest that the basic

surgical principle of incision and drainage in the treatment of certain abscesses of the brain might be replaced by total abscess dissection and primary wound closure.' Finally Le Beau advocates the principle of complete extirpation of brain abscess in one stage whether acute or chronic. With penicillin this is possible according to him, in most cases without the development of meningitis even though it may require opening the abscess and often the ventricle. Of his 17 patients thus treated, 3 died. They were all operated upon before the era of penicillin. Of the 14 patients who were cured penicillin was used in 13 and in 1 case no penicillin was used. In acute abscesses that is before the encapsulation he turns a flap, opens the dura, and removes not only the abscessed zone but also a large area of contiguous inflammatory and edematous white matter. Thirteen of the 17 abscesses were chronic and 4 were acute.

The review of the literature shows so far that there are on record 52 cases of total removal of brain abscess. In about half of the cases the lesion was diagnosed properly before the operation in the rest the abscess was taken for brain tumor and excised as such. Of those 52 patients, 8 or at the most 9 died after the operation while all others recovered and in no case did the removal of the abscess reactivate the inflammatory process. It should be re-emphasized that the fear of such a complication represents the main reason why so many who theoretically consider radical treatment as the most rational do not practice it more often.

PERSONAL OBSERVATIONS

Our personal observations deal with 43 cases of cerebral abscesses. In 33 instances the patients were operated upon in the Neurosurgical Service of Neurological Clinic University of Warsaw in 4 in the Hospital of the Good Friars in Cracow and in 6 in the Neurosurgical Service of the Neurological Clinic University of Cracow. In 17 patients the abscess was either drained or tapped and its contents evacuated and in 26 patients the lesion was extirpated radically.

Here, we are interested solely with the 26 patients given radical treatment. In 12 of

those cases the abscess was of traumatic origin in 6, the source of infection was not determined. 5 abscesses were of otogenic origin in 2 cases the abscess developed in connection with osteomyelitis of the skull and in 1 case most probably after erysipelas of the face. In 12 cases the pus contained *Staphylococcus aureus nonhemolyticus* in 2 hemolytic staphylococcus and in 3 nonhemolytic streptococcus. In 9 instances no bacteriological examination of the pus was carried out due to the very difficult wartime conditions of hospital work. These conditions were the reason no autopsy was done on 1 of the 2 patients who died in the hospital after the operation.

Two patients were operated upon 1 month after the infection 5 two months after 6 three months after 1 ten months after 4 one year after and in 8 patients the duration of the disease was unknown. More precise data were obtained as to the duration of symptoms from their first appearance to the time of operation. 1 patient was operated upon 2 weeks after it was clear that the injury of the head which he sustained several months previously had produced a brain abscess. 2 patients were operated upon 3 weeks after the onset of the first signs of the disease. 1 four months after 1 five months after and 2 twelve months after. In 2 patients the duration of the symptoms was unknown.

In 8 instances the cerebral abscess both posttraumatic and resulting from osteomyelitis of the skull was complicated by an active skin fistula. In 9 cases the capsule ruptured during the operation while in 9 cases it was opened intentionally to facilitate the removal of an abscess of large dimensions. Thirteen patients had an abscess more or less deeply located in the white matter and in 12 cases its upper pole was reaching the cortex. In 1 patient whose case history was lost the exact location of the lesion is unknown. In 24 patients the abscess wall was thick measuring from several millimeters to 1.5 centimeters and more in width in only 2 instances was the capsule thin although in 1 patient, the abscess was of 5 weeks and in another of 8 weeks duration.

In 6 out of the 26 cases the abscess was diagnosed before the operation as brain tu-

mor In the remaining cases the diagnosis was accurate. One patient has had 3 cerebral abscesses 4 patients have had 2 abscesses and in the other patients the lesion was single. In 1 case there was a cerebellar abscess in the other cases, the abscesses were located in the cerebrum. Two patients were operated upon twice all others were operated upon only once. One patient left the hospital 16 days after the operation 1 eighteen days after and 3 nineteen days after. Light went home 3 weeks after the enucleation of the abscess, 5 one month 4 one and a half months 1 two and a half months and 1 seventy days after.

Two patients died 1 of these from meningitis for which he was readmitted to the hospital 2 months after a successful removal of a brain abscess. The meningitis developed acutely after the patient who felt entirely well hit a beam with his head. He had been wounded by several fragments of a bomb and only one of these had been removed together with the abscess during the operation. It may be therefore that he had a second abscess unnoticed at the time of operation which ruptured after the trauma and produced the fatal meningitis. The second patient died 2 weeks after the operation with symptoms of streptococcal meningitis. This patient whose abscess followed an osteomyelitis of the skull, had had symptoms of meningitis long before the ill advised operation was performed.

The ultimate fate of 2 patients is unknown although they were feeling well for about 3 years after the operation. Twenty patients recovered fully and were followed up from 2 months to 7 years after the operation. Only 1 patient did not regain the use of his speech lost because of brain destruction at the time of his injury although his hemiplegia improved markedly. Another patient has a permanent hemiplegia. Of the followed up cases in 1 patient 2 months have elapsed since operation in 4 three months in 4, four months in 1 five months and in 1 one year. The rest 16 9 patients were operated upon 1 to 7 years ago. Only 1 of the 9 patients followed up for more than 1 year after the extirpation of the abscess, is still troubled by epileptic seizures which developed almost immediately after his head injury.

The following observations will illustrate some of the problems which one encounters in dealing with a rather typical, uncomplicated cerebral abscess.

CASE 1: B. M., aged 15 years, was referred to the Neurosurgical Service of the Neurological Care, University of Warsaw, on December 29, 1945 (history No. 1774) by Professor E. Herman of Lódz with a tentative diagnosis of brain abscess. In October 1945, the patient was wounded with a knife in the left parietal region of the skull. After a few days, the skin wound healed completely but the patient noted loss of sensation in the second finger of his right hand. One month later, he began to suffer from headaches and a fistula discharging a purulent fluid appeared at the site of the previous skin wound. The fistula closed after several days, but the patient began to complain of attacks of numbness in the right half of the lip, the tongue and in the right hand. Twice the attacks of numbness were followed by loss of consciousness and clonic movements in the right upper extremity. Physical examination showed temperature 36.6 degrees C., pulse 74. In the left parietal region of the skull there was a scar adhering to the bone. The x-ray pictures of the skull showed a small defect in the left parietal bone and in the middle of it, a foreign body the shape of a broken knife. He had no signs of meningitis but had a hyperemia of both optic discs, especially of the left. There was also an astereognosis and loss of sensation of position and movement of the fingers and of the right wrist. Examination of the blood and the cerebrospinal fluid was essentially negative. With the diagnosis of a cerebral abscess in the left parietal lobe the patient was operated upon on January 10, 1946. An osteoplastic flap was turned down with the bone defect in its center. During the breaking of the bone flap the tip of the broken knife was extracted from the scar filling out the bone defect. It was however still in the dura which was adherent to the leptomeninges. The blood vessels of the cortex were seen to be cuffed by a white exudate. The swollen brain was incised parallel to the dura made out of the dura and the leptomeninges and after the abscess, the size of a large plum, located just beneath the cortex, had been dissected free from the surrounding softened brain tissue, the whole mass was removed intact. The brain rapidly filled in the cavity resulting from the removal of the abscess. The dura mater was only partially closed because of the tendency of the brain to prolapse. The bone flap was returned to its place and a rubber drain introduced between the oozing bone and the skin. The abscess wall was 1 centimeter thick, the pus dense and greenish. Unfortunately there was no bacteriological examination of the pus.

The patient withstood the operation well having only a transient paresis of the right upper extremity and a motor aphasia. In the evening, the temperature rose up to 39 degrees C., the following evening descending down to not more than 37.5 degrees C. The fourth day after the operation the sutures were re-

removed and the wound found to be healing by primary intention. However 3 days later the skin opened in one place and there was a cerebrospinal fistula which closed after 1 week. On February 5, 1946, twenty five days after operation the patient left the hospital feeling well. Sixteen months later he is well and working and except for an asterognosis of the right hand has no signs or symptoms of his previous disease.

The patient was operated upon 3 months after the head injury and 8 weeks after the appearance of the first signs of the abscess. Under these circumstances we felt sure that it would be already well formed and firmly encapsulated. Our supposition was confirmed. Sixteen months have passed since the operation and we feel therefore that we are entitled to presume that the removal of the abscess did not cause an inflammatory process to flare up which might eventually persist in the vicinity of the abscess. In 16 months this would certainly have betrayed itself by some symptoms.

The brain tissue about the abscess was markedly softened a finding frequently observed in these lesions. However this is by no means an indication of an active inflammation about the abscess. Quite the contrary these changes as pointed out by Penfield (41) spreading sometimes in both hemispheres may be quite unassociated with encephalitis. The perivascular exudate seen in the cortex of this, as of many other patients may be according to Penfield (41) the only superficial evidence of a brain abscess when it is situated deeply in the brain. The exudate is the expression of the work of macrophages which are discharging both here and in the white matter the products of disintegration of the brain tissue.

Neither the blood nor the cerebrospinal fluid of the patient showed any signs of abnormality. This is in agreement with the experiences of many observers in cases of encapsulated cerebral abscesses. Woltman who studied the problem of the changes in the cerebrospinal fluid in cases of brain abscess has come to the conclusion that once the purulent encephalitis is localized and encapsulated the polymorphonuclears disappear from the fluid and their place is taken by the lymphocytes. A small number of lymphocytes would seem

on the whole to indicate better encapsulation, greater resistance and a smoother convalescence after operation. The persistence or reappearance of neutrophils suggest that encapsulation is not progressing satisfactorily. As is well known leucocytosis of the blood disappears in later stages of brain abscess either completely or is greatly lowered. A high leucocytic count in the blood suggests rather strongly that the purulent encephalitis has not been fully localized and walled off.

There were also no choked discs, the optic papillae of our patient being only slightly hyperemic. This too is in accordance with the experience of others. The presence of a papilledema is not necessary for diagnosis of a brain abscess. On the contrary, a high grade papilledema points to the fact that the encephalitis is still progressing or that the abscess is accompanied by serious swelling of the brain (32). The best time for operation is when the choked discs if present at all become stationary whereas when the papilledema is advancing the operation is usually dangerous.

CASE 2. H. W. aged 22 years was admitted to the Neurosurgical Clinic, University of Warsaw, on January 28, 1942 (case history No 966). Three weeks previously the patient had been hit with a knife in the left parietal region at once losing the power in his right extremities. The skin wound healed in 3 days, and 1 week after the injury the paralysis of the right lower extremity began to subside. However 2 weeks later he complained of headache, nausea and vomiting and the right lower extremity became once more paralyzed. The physical examination showed temperature 37.2 degrees C, pulse 50. There was a scar in the left parietal region of the skull but the x-ray pictures of this showed no fracture. The patient had no symptoms of meningitis but a slight papilledema, paresis of the right lower facial nerve, a complete paralysis of the right upper and a distinct paresis of the right lower extremity were present. There were no sensory changes, no aphasia, and reading, writing and counting were normal. The blood contained 9,050 white cells. There was little doubt but that the patient was suffering from brain abscess there was however some difficulty in determining its precise location so made. When attempting to puncture the left lateral ventricle in the occipital region a resistance was encountered at a depth of about 5 centimeters. After it was forced some 30 cubic centimeters of semifluid chocolate-colored nonodorous matter were aspirated through the exploring needle and then the cavity was

filled with air. The air was introduced also into the right lateral ventricle. The x ray pictures revealed in the left parieto-occipital region of the brain, a cyst measuring 2 by 2.5 centimeters and a dilatation of the right lateral ventricle which was slightly pushed laterally. The bacteriological examination of the contents of the cyst showed nonhemolytic streptococci. The abscess wall being very thin, there was of course no question of total removal of the lesion. It was decided therefore to wait for the firm encapsulation of the abscess and in the meantime should the condition of the patient call for it to aspirate it. This was done twice: once on February 17, 1942 and the second time on March 2, 1942. On the first occasion some 30 cubic centimeters of the same chocolate-colored matter containing nonhemolytic streptococci were evacuated whereas on the second only a few cubic centimeters of thick yellow pus which unfortunately was not examined bacteriologically were obtained. Between the first and the second puncture of the abscess the leucocytosis in the blood descended to 4,200 cells. The headaches, nausea and vomiting disappeared while the paralysis of the right extremities, especially of the arm, was slower to subside.

Finally on March 12, 1942 nine weeks after the injury and 7 weeks after the appearance of the first signs of the disease the patient was operated upon. An osteoplastic flap was turned down in the left parieto-occipital region and an abscess the size of a large walnut, found 3 centimeters beneath the cortex. Its capsule was thick and elastic. The consistency of the brain tissue around the lesion resembled that of an oligodendroglioma. With the aid of the sucker the abscess was dissected free from the brain and the capsule extirpated intact.

The postoperative course was uneventful, although once more there was a complete paralysis of both right extremities. The temperature after the operation was never higher than 38 degrees c. The cerebrospinal fluid examined 24 hours after operation was found to be sterile. On April 3, 1942 that is, 22 days after the abscess had been removed the patient went home feeling very well subjectively. Objectively there was complete subsidence of the papilledema and of the paresis of the right lower facial nerve and the paralysis of the right extremities was distinctly improving. During the first 3 years after operation, the patient felt well and was working. Later we lost track of him.

In spite of the fact that the abscess, situated 3 centimeters beneath the cortex and containing streptococci was tapped three times and then removed, there was no reactivation of the infection of the brain. The main reason for that is the resistance of the body to the organisms which provoked the original infection.

Since the first symptoms, i.e. paralysis of the extremities appeared immediately after

the head injury the symptoms of brain abscess following 2 weeks later it may be presumed that the first sequel of the trauma was an intracerebral hemorrhage which later became infected. This infected hematoma was finally encapsulated so that in the end we were dealing with a brain abscess proper. It is of course difficult to see what the method of invasion was in this case. Infection of a thrombus of some of the venae communicantes or a metastasis from a distant source? The skin wound healed 3 days after the injury and there was no osteomyelitis. It may be, therefore, that the infection of hemorrhagic focus came either from a latent otitis or sinusitis, or that it came from some distant source. The fact, however, that the paralysis of the extremities appeared immediately after the injury as well as the chocolate color of the pus point rather conclusively that the primary lesion was an intracerebral hemorrhage.

As is well known circumscribed intracerebral hematomas often diagnosed as brain tumor are by no means a rarity. Knickel dealt with them extensively. The gliosis of the brain found in this case about the abscess, presents another argument for the assumption that the original lesion consisted here in an intracerebral hemorrhage. However it must be added that instead of softening of the brain tissue around the abscess one may sometimes encounter gliosis and giant cell formation, especially when the abscess is well tolerated. Such changes may sometimes be seen throughout one or even both cerebral hemispheres (41).

When the diagnosis of brain abscess was made the capsule of the abscess was still very thin so that it could be tapped only. Had symptoms of intracranial hypertension been more severe or had they not subsided after the first aspiration we would have made a decompression followed by repeated aspirations. Yet even if this had contributed to the disappearance of the disease we would not have been satisfied but would have tried later to excise the capsule. We would have done this from fear that the capsule left in situ might provoke epilepsy.

CASE 3. K. S., aged 20 years, was referred to the Neurosurgical Service of the Neurological Clinic

University of Warsaw on January 5 1946 by Dr K. Kessel from Sochaczew because of aphasia and Jacksonian seizures resulting from a craniocerebral injury sustained 10 days previously. He was hit in the left frontoparietal region of the head by a blunt instrument he did not lose consciousness and felt quite well for 3 days. Then he had his first seizure of 'movements' in the right extremities. In the hospital in Sochaczew he had two similar attacks recognized as Jacksonian seizures. After the second seizure he lost the power in his right upper extremity and he became totally aphasic. For 3 days before admission he had been complaining of frequent vomiting. On admission, the neurological examination showed temperature 37 degrees C pulse 56 and in the left frontoparietal region of the head, near the midline a small longitudinal scar covered by a coagulum of a yellow fluid. X ray pictures of the skull revealed no fracture. There was a complete motor aphasia a papilledema on the left hyperemia of the right optic nerve, a paresis of the right lower facial nerve some rigidity of the neck, a complete paralysis of the right upper and a definite paresis of the right lower extremities. The cerebrospinal fluid contained 1.6 per cent of protein and 190 cells 61 per cent of which were polymorphonuclears and 39 per cent lymphocytes. There was no leucocytosis in the blood. After the admission the condition of the patient, who was somnolent confused and soiling his bed, began to deteriorate. Therefore it was thought advisable to do a large decompression of the brain exploring the site of the injury inasmuch as the possibility of a subdural hematoma could not be excluded. On January 11 1946 a large osteoplastic flap was turned down over the left frontoparietal region of the brain. The dura mater which was very tense and did not pulsate was adherent near the midline in the leptomeninges. The brain was swollen anemic and the majority of the cortical blood vessels were cuffed with a white exudate. When the adhesions between the dura mater and the brain were gently ruptured the cortex broke open in one place and began to discharge pus. This was immediately removed by suction and when the whole abscess cavity was apparently empty almost the whole area of the exposed brain fell in. Since the hole in the cortex through which the pus was aspirated was not larger than that which would be left by an exploring brain needle we confined ourselves to what had already been done the whole procedure amounting therefore to a large decompression of the brain with opening of the dura mater and evacuation of the pus. Bacteriological examination of the pus showed that it contained *Staphylococcus albus*. The postoperative course was at first uneventful and although the patient, who was receiving sulfonamides had a temperature rising to 39 degrees C. his general condition was improving. He gradually improved and ceased to soil his bed. The cerebrospinal fluid examined a week after operation contained only 3 cells and 0.165 per cent of protein. However, 8 days after the operation he had his first bout of high temperature rigidity of the

neck, somnolence and then 18 days later a second bout. Blood examination showed a leucocytosis of 13 950 the cerebrospinal fluid was sterile. We punctured the abscess cavity but found no pus. Unfortunately the skin incision through which the abscess was tapped would not close and a brain prolapse developed. Coincident with that the paralysis of the right upper and the paresis of the right lower extremity began to subside and in 2 weeks disappeared completely. Daily dressings and lumbar punctures brought the prolapse to healing so that on April 13 1946 that is 3 months after the operation the patient could leave the hospital, still aphasic but feeling otherwise entirely well. He had no leucocytosis and the cerebrospinal fluid was normal. Since his operation he has had no epileptic seizures.

He went home without any signs or symptoms except aphasia, yet he was warned that he might suffer from epilepsy both because of his original brain injury and because the abscess wall had been left *in situ*. He was of course advised to take luminal.

For about one month and a half the patient's condition was very good but then the epileptic seizures reappeared both generalized, and also confined to clonic movements of the right half of the face and the right extremities. The generalized attacks with loss of consciousness occurred once a week whereas the Jacksonian seizures, starting always with turning of the eyes to the right, returned more frequently lately even several times a day. Since the operation he had been taking 1 gram of luminal daily. He was readmitted on October 3 1946 nine months after the evacuation of the abscess the neurological examination revealed nothing abnormal except for motor aphasia which was not improving at all. The examination of the blood and the cerebrospinal fluid was essentially negative.

Assuming that the aggravation of the patient's epilepsy was due to the presence in the brain of the capsule we decided to excise it. Consequently on October 10 1946 the skull was reopened and a brain scar the size of a large plum, consisting of connective and gliotic tissue excised. During the excision the left lateral ventricle had to be opened, the cicatrix reaching down to its upper wall. The postoperative course was again at first rather stormy, the patient having a temperature over 39 degrees C. His right upper extremity once more became paralyzed and the lower distinctly paretic. The cerebrospinal fluid examined several times was found on all occasions to be sterile but containing up to 1 720 white cells (80 per cent polymorphonuclears and 20 per cent lymphocytes) and 3.3 per cent of protein. There was no leucocytosis. This state of affairs lasted for 3 weeks and then definitely improved although the skin incision opened in one place and there was a cerebrospinal fistula which closed only after several days. The paralysis of the right upper and the paresis of the right lower extremity began to subside and the patient felt subjectively well. In spite of the sterility of the cerebrospinal fluid we thought it safer to treat him with sulfonamides and

penicillin. He received therefore some 1,600,000 units of penicillin and a thorough sulfathiazole treatment. On November 16, 1946, six weeks after the excision of the scar, he left the hospital feeling entirely well. He was of course aphasic but the power in his right extremities was improving distinctly. He has had a minor attack in his right upper extremity only once during the 7 months which have elapsed since his operation. He was receiving 0.5 gram of luminal the same amount as before the scar excision.

It is of course much too early to say anything about the end result of scar excision in this patient; there is however no doubt that so far since his operation he has had practically no attacks whereas previous to the operation with the same dose of luminal they were very severe and occurred daily. Of course epilepsy may, as pointed out by Pennybacker, an otherwise good result in cases of brain abscess however treated and all of these cases should be kept on regular sedative treatment for several years after operation. Yet it seems to us that leaving the capsule *in situ* will not improve matters but certainly add to the irritation of the damaged brain.

CASE 4. S.M. aged 20 years, was referred to the Neurosurgical Service of the Neurological Clinic, University of Warsaw, on November 14, 1943 (case history No. 1750) by Dr. J. Kalisz, of Lodz, with a tentative diagnosis of brain abscess. One year previously the patient had had erysipelas of the left half of the head and the face accompanied by symptoms of general toxemia and meningitis. He remained seriously ill for some weeks and after that complained of headaches localized in the left temporal region. One month ago his temperature rose, the headache became more severe and he complained of nausea. In the hospital in Lodz, a bilateral papilledema, signs of meningitis, a motor aphasia and a leucocytosis in the blood and in the cerebrospinal fluid were found. After a thorough treatment with sulfonamides the general condition of the patient improved greatly yet the choked discs and motor aphasia remained. On admission to the Neurosurgical Service the patient was confused, had a temperature of 36.8 degrees C., pulse 60, a definite sensitivity of the left temporal region to percussion, a bilateral papilledema, no signs of meningitis, a dilatation of the left pupil, paresis of the right lower facial nerve and of the right upper extremity and a definite sensory aphasia. The cerebrospinal fluid containing 0.66 per cent of protein and 26 lymphocytes in 1 millimeter and showing positive globulin reactions was sterile. There were 9,750 white cells in the blood. The patient was operated upon on November 23, 1943, with the diagnosis of an abscess in the left tem-

poral lobe. After an osteoplastic flap had been turned down and the dura, strongly adherent to the leptomeninges over the posterior parts of the temporal convolutions incised, an abscess was found some 3.5 centimeters underneath the cortex, the size of an apple. It was easily dissected from the surrounding softened brain tissue. However during the removal of the abscess its capsule ruptured so that the pus had to be aspirated. Only then was the capsule extirpated. However there was another abscess, somewhat smaller beneath the first abscess, and located a little posterior to it. It was removed without the capsule being incised. The brain, which had a tendency to prolapse, fell in so that there was no difficulty in closing the dura. The cranium of the brain was filled out with Dakin's solution. The patient who withstood the operation well had an eventful recovery. For 4 days he was treated with penicillin given intramuscularly and 3 days later he was afebrile. The paresis of the right upper extremity and the motor aphasia subsided 3 days after the removal of the abscess and on December 17, 1943, twenty-four days after operation, he was able to leave the hospital with only a slight paresis of the right lower facial nerve.

Until the middle of April 1946, that is, for 4 months, he felt well; then one day the headache in the left temporal region reappeared and he developed a paresis of the right extremities. The site of the decompression became tense, the skin incision opened in two places and began to discharge a purulent fluid. He was therefore readmitted to the Neurosurgical Service on May 9, 1946 (case history No. 1815). The physical examination showed at that time a temperature of 37 degrees C., pulse 68. The patient was psychically clear without disturbances of speech. The bone flap was somewhat elevated and did not pulsate. There were two small purulent skin fistulae in the line of incision covered by coagulated pus. He had no symptoms of meningitis but had a papilledema, especially on the left, a distinct paresis of the right lower facial nerve and of both right extremities and a hypoesthesia over the right side of the body. The cerebrospinal fluid was sterile. There was no doubt that the patient was suffering from a third brain abscess which had either existed at the time of the previous operation but gone unnoticed, or had been provoked by infection of the operative wound. Since a precise localization of the lesion was definite, ventriculography was carried out on May 21, 1946, the x-ray pictures of the skull showing definite compression of the anterior horn of the left lateral ventricle. In view of the diagnosis of cerebral abscess in the left frontal lobe the patient was reoperated upon. The two skin fistulae, underneath which some small bone sequestra were found, were excised and the bone flap raised. The dura was tense and did not pulsate. After it had been opened a large abscess, located anterior to the frontal edge of the skull defect, was found. Its posterior pole was covered by the cortex while the anterior pole was lying outside the frontal lobe, adhering strongly to the dura mater. The ab-

was containing some 50 cubic centimeters of thick pus, was with some difficulty dissected free from the dura and finally removed intact. The cavity of the brain was filled out with 10,000 units of penicillin in 10 cubic centimeters of normal saline solution and a rubber drain left for 24 hours. The operation was followed by complete aphasia and an almost complete paralysis of the right extremities. However, the latter subsided after a few days and a week later the patient's speech became normal again. The next day after operation, a second dose of 10,000 units of penicillin was introduced into the abscess bed and on the third postoperative day 10,000 units of penicillin were given intrathecally. One week later the patient had no temperature and both penicillin given intramuscularly (25,000 units every 3 hours) and the sulfonamides were stopped. The bacteriological examination of the pus of the third abscess showed the presence of *Staphylococcus aureus*. The cerebrospinal fluid examined three times during the patient's stay in the hospital was always found to be sterile. On June 6, 1946, nineteen days after the second operation the patient returned home feeling well and with no signs or symptoms of his disease. When seen 10 months after the removal of the third abscess he was found to be completely well.

Unfortunately the pus from the two abscesses removed at the first operation was not examined bacteriologically. We suppose however that these two abscesses resulted from infection of the brain by streptococci which previously caused the erysipelas. The third abscess extirpated at the second operation was due to staphylococci which certainly caused the osteomyelitis of the skull also. Both the osteomyelitis and the brain abscess found at the second operation resulted most probably from wound infection at the time of the first operation. In all events the third abscess containing staphylococci could not be a result of erysipelas produced by streptococci. Case 3 of Vincent David and Ashkenazy (53) is somewhat similar to our Case 4 inasmuch as they too found two abscesses in their patient at the first operation while at the second performed sometime later they encountered a third abscess. Their third abscess also resulted from infection but whereas in our patient the infection came most probably from outside in their case the recurrence of the abscess was due to the fact that they left a portion of the capsule of one of the abscesses at the first operation. The thickness of the wall of their third abscess was almost the same as that of one of the two re-

moved 3½ months previously. They believe therefore, that the thickness of an abscess wall depends more on the individual reaction of the body to the pathogenic organisms than on the duration of the disease. We agree with that but with this reservation, that both the duration of the disease and other factors are playing an important rôle in this connection. We agree with them not because our third abscess was as thick as the two removed 6 months previously but on the ground of the observations made in other cases. After all we do not know that all the three abscesses of our patient did not develop simultaneously. If our assumption that the two first abscesses resulted from the erysipelas is true, then our patient should consider himself lucky, the metastatic abscesses being usually more numerous. In one case of Bergmann (5) of pyemia following gangrene of the bones of the leg, the patient had had 100 cerebral abscesses.

During the removal of one of the first two abscesses the capsule of the abscess ruptured. It is true that the pus was immediately sucked out yet it must be admitted that some of it could have come into contact with the brain. He was treated with penicillin. It is possible therefore that the absence of any serious complications in this case as in 8 other cases is to be referred to the action of penicillin but in 3 other cases in which the capsule was incised during the operation and in which no penicillin was given there was also no infection of the meninges. These last patients were operated on some 3 or 4 years ago and as they are quite well there is no more danger of recurrence of the abscess. The body which has once mastered an infection of the brain by localizing and encapsulating it is apparently quite able to resist a new infection by the same organisms. The experiences of Krause Kahn and Le Beau who during operations for cerebral abscess several times opened the lateral ventricle without endangering the life of the patient seem to support that view.

According to Hamilton Whitcomb and Woodhall the value of penicillin is highest in the stage of encephalitis which precedes an abscess formation. It helps to localize the inflammatory process. It may also play a great rôle in the treatment of brain abscess by pre-

venting the spread of the infection. Finally it may sterilize the pus. Since it is almost impossible for penicillin to pass through a capsule the best way to sterilize an abscess is to inject the drug into its cavity. This may be done in doses of 50,000 to 75,000 units once a day or as was practiced by Shelden, Pudenz, and Craig, doses of 3,000 to 6,000 units given every 3 hours through a small rubber catheter. Besides that the patient receives 50,000 units intramuscularly every 3 hours.

CASE 5. D. V., aged 45 years, was admitted to the Neurosurgical Service of the Neurological Clinic, University of Warsaw, on May 30, 1946 (case history No. 1868). One year previously the patient had been hit in the right frontal region by a fragment of a shell. He lost consciousness for several minutes. After a few days he was otherwise well but had some headaches and at the site of his injury a fistula, discharging a seropurulent fluid, appeared. Some months ago two small bone sequestra emerged through the fistula. For 1 month the headaches became very intense and he complained of nausea and vomiting. Physical examination showed a temperature of 36.7 degrees C, pulse 68. In the right frontal region, some 4 centimeters above the superior ridge of the orbita and almost at the midline, a fistula, discharging pus, was found. X-ray films of the skull revealed a defect here measuring 1 by 0.5 centimeter. The patient showed no signs of meningitis but there was a choked disc on the right, a slight paresis of the left lower facial nerve, a sterile cerebrospinal fluid containing 0.66 per cent of protein and showing positive globulin reactions. There was a leucocytosis.

The patient was operated upon, with the diagnosis of a brain abscess in the right frontal lobe, on June 7, 1946. The edges of the fistula, which were adherent to the borders of the bone defect and to the dura, were excised; the bone defect enlarged to a size of 6 by 6 centimeters, and the dura opened parallel to the edges of the bone defect. Immediately underneath and adhering to it, an abscess the size of a large apple, adhering at the midline to the falx cerebri but otherwise surrounded by softened brain tissue, was encountered. Because of the size of the abscess, it was difficult to extirpate it intact; therefore its capsule was incised and the pus sucked out. The adhesions to the falx were gently ruptured and the capsule dissected free from the brain. The cavity in the brain was filled out with 10,000 units of penicillin in 10 cubic centimeters of normal saline solution and a rubber drain left between the skin and the highly vascularized bone flap. Bacteriologically the pus contained *Staphylococcus aureus*. The next day after operation the temperature was between 37 and 38.2 degrees C, there was a slight rigidity of the neck and some headache. The drain was removed after 24 hours and another 10,000 units of penicillin injected into the abscess bed. Two days later the cerebro-

spinal fluid was withdrawn for bacteriological examination and 10,000 units of penicillin given intrathecally. The fluid was found to be sterile. The temperature rising up to 38.9 degrees C, continued a few days and the patient complained of headache and rigidity of the neck. However, a week later it was well and without temperature, so that both penicillin and the sulfonamides were stopped. On June 23, 1946, sixteen days after operation, he was home without any neurological findings. When seen 8 months later he was found to be entirely well.

Even an active skin fistula is not necessarily a contraindication to removal of an abscess. However, in these cases, the brain should be exposed as little as possible; that is, only by enlarging the already existing bone defect to a size necessary for removal of the capsule. The pus should be previously aspirated. Of the 7 patients who had such a complication of the cerebral abscess, 5 recovered and in the 2 who died the infection of the brain and the meninges was not a result of operation.

The patient was operated upon 1 year ago, so we cannot be sure whether he is completely safe from a recurrence of the abscess. However, we have here an additional proof that total removal of an abscess, complicated by a purulent skin fistula, is not necessarily always followed by an encephalomeningitis.

CASE 6. W. U., aged 27 years, was admitted to the Neurosurgical Service of the Neurological Clinic, University of Warsaw, on December 3, 1946 (case history No. 3105). She gave the following history. In September 1944, she was wounded in the right parietal region of the skull by a piece of shrapnel. She immediately lost consciousness and her left extremities became paralyzed. For the next 7 months the wound discharged a purulent fluid. Six months after the injury she developed epilepsy consisting of attacks of loss of consciousness and clonic movements in the left side of the face and left upper extremity. In September 1946 she was operated upon because of her epileptic seizures; some superficial operation was performed. In spite of that and of the treatment with luminal (0.2 gm. daily) she continued to have seizures which had lately become more frequent. Since November 1946 she had had bouts of temperature rising to 39 degrees C., complained of headaches, nausea, vomiting, and loss of memory.

On admission the patient, who had a temperature of 39 degrees C., a bilateral papilledema, a left hemiparesis with the sign of Babinski, a bone defect in the right parietal bone measuring 3 by 4 centimeters, covered by an unhealthy skin with a purulent fistula, was co-operative. There were no signs of meningitis. Six hours later she became unconscious and there was a marked bradycardia. A diagnosis of brain ab-

les in the right parietal region of the brain complicated by encephalitis was made and the abscess enucleated. The 20 cubic centimeters of thick, greenish pus aspirated from it contained *Staphylococcus aureus*. The condition of the patient next day was only slightly better, she continued to be very markedly stuporous and the heart beat was still very slow. Consequently the region of the lesion was exposed and the abscess extirpated intact. Its capsule was very thick and partially calcified; the surrounding brain more softened than is usual in these cases. The postoperative course was stormy; the skin closure breaking open and facilitating a huge brain collapse. For 4 weeks the patient was very excited and confused and spoke only French. The temperature was 39 degrees C. but there were no signs of meningitis and the cerebrospinal fluid was continually sterile. After receiving about 6,495,000 units of penicillin (20,000 units into the abscess bed, 150,000 units intrathecally and 5,735,000 intramuscularly) and 133 grams of sulfathiazole (by mouth) she was discharged on February 12, 1947 without temperature headaches or attacks, etc. She felt subjectively well; her skin incision had closed completely. When seen 3 months later she continued to be well free from attacks with only the left hemiparesis which had developed after the head injury in 1934 remaining.

Here is the case, our only case, in which the brain abscess was removed in the presence of an encephalitic bout. Undoubtedly the fact that the patient recovered is wholly due to the chemotherapy. What will be the future of this patient? We will have to wait and see but certainly the removal of a rather large abscess and the dissection of this abscess from the surrounding inflamed brain tissue, did not provoke a fatal meningitis. As mentioned Le Beau radically attacks even the acute abscesses of the brain, that is, he treats surgically the acute stage of the disease. Of 3 patients thus dealt with 2 died and 1 recovered. It will be for the future to decide whether success will crown the surgical treatment of purulent encephalitis but the beginning is certainly interesting and promising. It was 11 years ago when King (25) was wondering whether sucking out septic brain material would not one day be utilized in certain suitable cases of suppurative encephalitis or phlegmon of the brain in which there is but little tendency to encapsulate.

GENERAL COMMENT AND CONCLUSIONS

In conclusion the problem of the radical treatment of cerebral abscesses can be summa-

rized as follows. Purulent encephalitis is either mastered by the body which encapsulates the inflammatory focus, or the infection takes the upper hand over the forces of resistance and the encephalitis spreads over one or even both cerebral hemispheres. The second event takes place when the virulence of the organisms is too great for the forces of defense. The surgeon is unfortunately, unable to influence this battle greatly on the contrary all surgical interference at the early stage of the disease was up to now harmful. Maybe the use of penicillin will change matters.

Experimental researches show that the formation of a capsule around the inflammatory focus starts at the end of the first week after the brain has been infected; the capsule becoming mature at the end of the third week of the disease. It then becomes resistant to the exploring needle and only then can one call such a lesion an abscess. However the victory of the body over the infection, resulting in abscess formation is at the end of the third week still too recent and the wall of the abscess is still too thin to allow it to be treated radically that is, to be removed intact. The best time for this is, according to our experience the eighth week after the infection.

During the first 3 weeks of the disease all surgical intervention is usually harmful. If one loses a patient during that period the reason is found in the ability of the body to overcome the infection. At this stage of the disease the causative treatment may consist only of the administration of penicillin which facilitates the limitation of the process of inflammation. Between the third and the eighth week a single or, if necessary repeated aspirations of the pus are sometimes indicated. Such a procedure can even lead to the subsidence of all the symptoms of the disease. Penicillin introduced into the cavity of the abscess arrests, sometimes completely the growth of the organisms. It can be given in doses of 10,000 to 75,000 units for 24 hours or of 3,000 to 6,000 units every 3 hours through a small indwelling catheter. If after single or repeated aspirations of the abscess the symptoms of intoxication and increased intracranial pressure do not disappear a decompression of the brain through an osteoplastic flap may seem to be indicated.

However the capsule of an abscess cured by aspiration or drainage when left behind is apt to produce epileptic seizures some time later. It is in general difficult for us to find the reason why drainage of an abscess should be preferred to its total removal. For we feel that, on the contrary when successful radical treatment of a brain abscess may it be of otitic traumatic or metastatic origin is as safe as drainage and cures the patient more quickly and more completely. Noteworthy also is the almost complete recovery observed in the majority of cases treated radically. This may be due to the fact that most often cerebral abscesses are located within the white matter where they have a tendency to expand the tracts involved rather than produce their actual destruction. After the removal of the abscess the brain edema subsides the circulation improves and function returns. The radical method of treatment is, of course not free from failures but neither are any surgical interventions. At all events neither our own experience nor that of others confirms the fears expressed by some that the act of separation of the capsule from the surrounding brain tissue is dangerous producing a flare-up of the inflammatory process which may be present even about an encapsulated abscess. No doubt such a complication is possible and probably does sometimes happen. The body however usually takes good care of it being at this stage of the disease wholly resistant to the pathogenic organisms which produced the initial infection.

We do not fear the consequences of a premeditated opening or of a rupture of the capsule during the radical procedure although we take great care of course not to let the pus be spread over the operative field. Indeed experience has taught us that even when the pus, containing organisms comes into contact with the brain this is not necessarily followed by its reinfection the resistance of the body being already well established. It must also be added that the pus of a chronic abscess is often sterile or else the virulence of the organisms is diminished. This is said to be the result of encapsulation of the pus. Finally we are not afraid to extirpate an abscess complicated by an active skin fistula, being persuaded that if the patient

has had no widespread encephalomeningeitis before the operation his resistance to the organisms maintaining the activity of the fistula is sufficiently proved. On the other hand it would seem that an infection of the brain or the meninges by organisms other than those which produced the primary lesion, presents a serious complication. Such a complication however is not peculiar to surgical intervention for brain abscess. The use of sulfonamides and of penicillin may still more enlarge the indications for radical treatment of cerebral abscess those two agents being able to remove the chief contraindication to it, which is, namely a concomitant purulent leptomeningitis. That complication is the main reason why all other methods of treatment are usually of no avail.

Strong and diffuse adhesions between the capsule of the abscess and the dura mater make the removal *in toto* very difficult. In such a case the best thing to do is to aspirate the abscess, instill penicillin into its cavity and then after the infection has been brought to a standstill excise the capsule as you would a brain scar. In such cases, Le Beau advocates the removal of the capsule in fragments.

As a rule the removal of an abscess is quite an easy procedure, the brain tissue surrounding the abscess being in our experience usually softened and the capsule poorly vascularized. The abscess is usually dissected free from the brain with the aid of the sucker and then enucleated gently with the finger. Adhesions between the dura and the leptomeninges are closing up of the subarachnoid spaces about the abscess are provoked by electrocoagulation or painting of the meninges with a 5 per cent tincture of iodine. However this is rarely necessary as the subarachnoid spaces are usually closed by spontaneous adhesions. This happens not only in cases of an abscess located superficially but also in those in which the lesion is situated deep under the cortex. One should avoid leaving behind, in the cavity the brain strips of muscle, fascia, and some tissues facilitating hemostasis. We are also careful to remove all of the necrotic brain tissue which is of course, an excellent medium for the growth of micro-organisms. Dakin's solution is used throughout the operation in Ben-

normal saline solution. Before closing we introduce into the cavity in the brain left after the extirpation of the abscess as a prophylaxis 10 000 units of penicillin in 10 cubic centimeters of normal saline solution. The same amount is injected here the next day and the third day after operation. 10 000 units of penicillin are given in 3 cubic centimeters of cerebrospinal fluid intrathecally on the occasion of the withdrawal of cerebrospinal fluid for bacteriological examination. Penicillin is also injected intramuscularly (25 000 units every 3 hours) especially when the abscess follows a still active inflammatory focus in the middle ear or in the sinuses etc. When the temperature falls and shows no tendency to rise for 3 consecutive days penicillin is discontinued. In our patients this was usually done a week after operation so that the average amount of penicillin given to them did not exceed 1 500 000 units. All our patients were also given various sulfonamides most often dibazol in doses of 2 grams every 4 hours for 2 days then 3 grams every 8 hours, or 5 grams every 12 hours. As a rule the abscess bed is not drained but when it was necessary we did drain the cavity using strips of a rubber glove but only for 24 hours. The dura is usually closed completely.

Using this method in 26 cases of cerebral abscesses (including one cerebellar abscess) of various origins we obtained in 24 cases a more or less complete recovery. Two patients died. The operative mortality in those 26 cases in which the abscess had been radically removed was therefore less than 10 per cent. The comparison of these results with the results obtained by us when using simple aspiration of the pus or drainage of the abscess explains why we are now strong partisans of radical treatment. Of the 9 patients in whom the abscess was aspirated only 5 were cured and the other 4 patients died. In 5 of these the aspiration of the pus was made after the brain had been widely exposed in 4 cases through a small burr hole. Of the 8 cases in which the abscess was drained 6 survived and 2 died. In 4 patients the drainage was performed after an osteoplastic craniotomy and in 4 through a small opening in the bone. The operative mortality of these 17 patients was therefore 35.3 per cent, that is, three times greater than the mor-

talidity of the 26 patients treated radically. In both groups of cases the treatment was instituted at almost the same point in the course of the disease.

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CONGENITAL ANOMALIES

I RECALL many years ago visiting the office of the medical director of one of the large insurance companies. Three of the secretaries had obvious congenital anomalies. The inquiry was made whether these young women were employed on account of the kindheartedness of the director and from charitable motives. The answer was no—that they were the best secretaries he had ever had and that he believed their defects acted as an inspiration to keep them on the job and always to be polite and courteous. He believed their defects were assets—not liabilities. He further stated that if he had to employ another secretary he would be inclined to search for one with a physical defect.

This incident is cited for the purpose of stimulating those who work to help those individuals affected by congenital defects and to suppress the pessimist who wonders whether it is worth while to devote time, money, study and energy to their relief.

It can be stated with conviction that there are not ten but hundreds or even thousands of individuals leading happy and useful lives who were born with congenital anomalies and whose parents were first told that nothing could be done for them only to find on further inquiry that the defects could be cured or at least much improved.

The advance that has been made in the last twenty five years in treating these conditions is striking. In the first decade of this century the number of patients afflicted with cleft lip and palate who after numerous operations had been performed presented an unsightly scar on a deformed lip and a mutilated palate with defective speech was enormous. Although today these unfortunate results still take place the number is steadily decreasing. On the other hand the number of patients with these defects who after two or three operations present a well formed lip with an inconspicuous scar and a well reconstructed palate that furnishes good function and little or no speech defect is constantly increasing.

Twenty or thirty years ago the cure of a patient with atresia of the bile ducts was unheard of and the recovery of a patient with atresia of the intestine was regarded as a surgical curiosity. Today although the mortality of these conditions is still unduly high the number of recoveries is on the increase.

Due to careful study of embryology and symptomatology intestinal obstruction due to the arrest in the rotation of the midgut can be recognized as a clinical entity and suitable and successful measures adopted for its relief. Likewise some knowledge of embryology is an important factor in the treatment of duplications of the alimentary tract.

Prior to November 1939 no patient so far as I know with esophageal atresia and tracheoesophageal fistula ever recovered. The condition was either unrecognized or the obstetrician and pediatrician alike advised the parents that a fatal termination was inevitable. Since that time many successful operations for this anomaly have been performed. The first patients to recover were subjected to numerous operations with the construction of an anterior thoracic esophagus. As the defect became more frequently recognized and the patients were brought to the hospital earlier and in better condition the operation of primary anastomosis of the two esophageal segments has supplanted the earlier operation except under rare circumstances. The roughly 60 per cent drop in mortality in congenital diaphragmatic hernia which has taken place in the last fifteen years could not have been achieved without the recognition of the feasibility of performing major surgical operations in the first few days of life and in this condition the necessity of selecting this time. It is important to recognize early the anomalies of the extremities and bony structures usually cared for by the orthopedic surgeon. Although these anomalies seldom are a threat to life, their early recognition frequently simplifies the treatment and makes the end result more satisfactory. The success of the treatment of cardiovascular defects which has been so striking in recent years has been made possible only by careful planning, thorough knowledge of the anomalies of the anatomy of the parts and improvement in anesthesia. Although the operations for these conditions are often not undertaken until later childhood many of the same factors are essential for a successful outcome that are required in the more acute emergencies.

The anomalies of the genitourinary tract are numerous and here again an intimate knowl-

edge of anatomy and embryology is important in the diagnosis as well as in their successful treatment. Such conditions as ectopic ureter, double ureter, hydronephrosis due to obstruction of aberrant vessels, hydrometrocolp, exstrophy of the bladder to mention but a few of the defects of these tracts, have all been successfully treated in recent years. However, their successful treatment has been dependent on familiarity with the possibilities, with factors of development, growth and power of compensatory hypertrophy, as well as experience.

I have mentioned here only some of the congenital anomalies which occur and have indicated that over the last twenty-five years or so much improvement has taken place in their treatment. There is still much to be done in this field which is a far larger one than is generally recognized.

In order to solve any problem and, in this instance to improve the lot of individuals handicapped by congenital anomalies, thoughtful planning is necessary. Careful training of the surgeon to cope with these conditions is obviously the first step. As Dr. Gallie pointed out in his presidential address to the American College of Surgeons, "The time allotted to the teaching of anatomy to undergraduates is being so reduced that none but a superman could be expected to acquire any practical knowledge of it. The same statement could be justly applied to embryology. Likewise in medical schools where the teaching of the basic sciences or preclinical subjects is sometimes in the hands of professors who have had no clinical training, or indeed who are not even holders of an M. D. degree, the correlation between their teaching and its clinical application must of necessity be fragmentary. These statements are made not as a criticism of the excellent preclinical teaching but as a suggestion that it obviously needs to be supplemented

and correlated with clinical work. With the multiplicity of subjects taught in the medical school of today probably the only practical way of adopting this plan would be in the post graduate training period. For the surgeon who is caring for the congenital anomalies the desirability of better training in anatomy and embryology is particularly obvious.

The common practice in children's hospitals of having the pediatrician make the surgical diagnoses running the preoperative and post operative care and calling a surgical consultant for the operation only is not a good one. This policy makes of the so called surgeon only a surgical technician or craftsman and the patient necessarily suffers.

Many congenital anomalies require major surgical operations in the first few days or hours of life. The surgeon who undertakes these operations should be familiar with the factors of early development of the infant of his feeding requirements of possible blood dyscrasias of the details of the electrolyte and water balance requirements. All these factors are greatly affected by the operative procedure and should be the responsibility of the surgeon and not of a pediatrician who cannot be familiar with the factors which alter the requirements and are so often very different from what he is used to. These comments are not intended to belittle the merits of the pediatrician but to suggest that he should occupy the more dignified position of consultant in which he can be of great help rather than to have responsibilities placed upon him which he may not be qualified to accept. In an analogous situation in adult surgery it is pertinent to ask if the surgeon relies on the internist to make his diagnoses and accept the responsibility for the preoperative and post operative care.

In the next few decades far greater advances in the treatment of congenital anomalies may

be anticipated than in the decades just passed. However this advance can take place only by having the surgical problems of early life handled by surgeons who are permanent members of the surgical staff of the children's hospitals rather than by occasional visitors for the purpose of performing a single operation. If surgeons take sufficient interest in the surgery of early life to acquire a better training and if they appreciate their opportunities and responsibilities the advance in the near future can be unpredictably great. To the surgeon who uses the monetary gauge as the only measure of success this field should not be recommended. If however the surgeon is satisfied with an adequate but modest income and gains more happiness out of making advances in lowering the mortality and improving the lot of those afflicted with anomalies this field of surgery offers great and very gratifying possibilities.

WILLIAM E. LADD

CONGENITAL ANOMALIES OF THE FEMALE REPRODUCTIVE ORGANS

EVERY gynecologist and obstetrician possesses at least an elementary knowledge of the embryology of the female sex apparatus—the formation of the genital ridge on the anterior or ventral surface of the mesonephros the appearance of the gonadal anlage the invagination of the celomic epithelium to form the muellerian ducts and the later fusion of the lower portions of the two muellerian ducts to form the uterus and most of the vagina while the upper unfused portions become the tubes. Knowledge of these few simple facts makes it easy to understand the mechanism of most of the congenital anomalies which he may encounter in practice. Various portions of the apparatus may be lacking completely (aplasia) or they may fail

to develop beyond the most primitive stages (agenesis) there may be a duplication of various segments or much more commonly there may be a partial or complete failure of fusion of the two muellerian canals. There are of course other possible anomalies affecting the lowermost portion of the vagina and the external genitalia these involving chiefly the derivatives of the urogenital sinus and often but not invariably being associated with anomalies of the upper or muellerian segment.

In the study of such genital anomalies one should always bear in mind that with them one often finds associated congenital anomalies of the urinary tract such as absence of the kidney, horseshoe kidney, ectopic kidney, or duplication of the kidney. Urography therefore should be a routine part of the examination of all such patients.

With any of the enumerated anomalies the sex characters of the woman as far as her general body development and her psyche are concerned may be typically feminine. Just why the local quirks in the development of the sex apparatus occur is still unknown. On the other hand there is another group of cases, numerically smaller in which anomalies of the sex apparatus are only a part of a more profound genetic disturbance involving those chromosomal factors which give the primary impetus to the development of the organism along male or female lines.

Sex determination dates from the moment of conception depending upon the particular chromosomal pattern of the male gamete. The resulting zygote, therefore, is dominantly male or female depending upon its genic balance, according to the well known theory of Goldschmidt. It is easily possible in some of the lower forms, to disturb and even invert this genetic sex balance and similar disturbances undoubtedly occur in the human. The earlier in embryological development such

extrinsic factors become operative, the more profound the sex changes which result. They are brought about the various forms of true hermaphroditism and pseudohermaphroditism.

While the nature of the disturbing factor is unknown in most cases, endocrinopathies of various sorts such as those associated with certain adrenal cortical tumors, when they develop in fetal or early postnatal life, exhibit at least one type of pseudohermaphroditism. A similar factor becoming operative at a later phase of development would produce a much less profound sex change usually some degree of other of virilism.

I have thought it desirable thus to sketch very briefly the factors concerned in congenital anomalies of the female sex apparatus rather than to try to discuss the latter categorically which would be obviously out of the question in a short communication such as this. While any of the abnormalities above indicated may at times be encountered in practice the most frequent are probably congenital absence of the vagina and usually with the uterus, imperforate hymen, the functional failures of the muellerian ducts, and hermaphroditism true and false.

The treatment of congenital absence of the vagina once a rather formidable problem, has become comparatively easy one is tempted to say almost ridiculously simple. The Baldwin operation so popular in a former day made possible the creation of a vaginal canal which, in my own experience at least, was more nearly perfect than that obtainable by any of the earlier modern methods. But it is no longer a justifiable procedure because of its magnitude and its very real hazard. This is even more true of operations of the Schubert type, in which a portion of the large bowel was utilized.

While even exceedingly simple methods like the test tube pressure plan of Frank, a

used by some and while others still lean to various plastic procedures of the Frank Geist or Graves type in which external skin grafts are utilized it is probable that the most satisfactory method in most cases is that of Wharton either with or without Thiersch grafts of the vaginal tunnel which can usually be so easily dissected out. Even without grafts the results are very satisfactory but the addition of the Thiersch grafts appears to be an advance though it may call for the co-operation of a trained plastic surgeon.

Most of the fusion anomalies of the müllerian duct involve the uterine segment producing all the well known variations designated by such terms as uterus didelphys uterus bicornis unicollis uterus septatus and subseptatus uterus arcuatus etc. Some of these have little practical importance others may give rise to serious clinical problems to either the gynecologist or the obstetrician. In only a minority of cases does the condition *per se* call for treatment but the complications to which it gives rise often do such as the ectopic pregnancy arising in a rudimentary horn or the obstetrical problem which can be produced in at least some cases of uterus didelphys as a result of blockage of the birth canal by the nonpregnant half of the double uterus.

As regards hermaphroditism and pseudohermaphroditism it is gratifying to note the advances which have been made in the treatment of these unfortunate individuals. No longer are they looked upon and perhaps even shunned as freaks of nature but in most such cases it is possible to make the lot of these patients quite tolerable and allow them to live their lives as useful members of society. True hermaphroditism is very rare. Young's compilation (1937) revealed only 9 genuine cases with only a small group since then.

The much more common pseudohermaphrodites are designated as male (pseudoherma-

phroditismus masculinus) or female (pseudohermaphroditismus femininus) according to the testicular or ovarian character of the gonad. This is ordinarily based on biopsy of the latter usually calling for exploratory laparotomy although in some cases one or both gonads are more easily accessible to biopsy since they may be situated in the inguinal canals or in the lateral portion of the external genitalia, the latter especially in the male pseudohermaphrodites with cleft scrotum. All sorts of combinations of either male or female gonads with accessory sex organs of one sex or another may be encountered and many interesting problems of surgical nature thus encountered.

Only a few cardinal principles can be touched upon here. The first and in my opinion the most important is that the male or female sex nature of the gonad plays a relatively unimportant part in deciding the sex to which the patient is so to speak to be socially assigned by the surgeon. Almost never should an adult patient be taken out of the sex category in which she has been raised. The psychologic upheaval which would follow such a step would be enormous and possibly tragic. It is important to know that individuals whose only gonads are testes may be typically female from such standpoints as psychology and libido toward men. Furthermore the local sex apparatus is far more easily conformed to the female type than the male, involving most often the comparatively simple problem of creating an artificial vagina. In many of these cases the clitoris is comparatively small with a urethral hypospadias so that it is simply impossible to convert it into a functioning male organ.

In the second place it should be remembered that the secondary sex abnormalities including the appearance of the external genitalia may often be the same whether the

to develop beyond the most primitive stages (agenesis) there may be a duplication of various segments or much more commonly there may be a partial or complete failure of fusion of the two muellerian canals. There are of course other possible anomalies affecting the lowermost portion of the vagina and the external genitalia these involving chiefly the derivatives of the urogenital sinus and often but not invariably being associated with anomalies of the upper or muellerian segment.

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THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

THE second edition of *Gynecological and Obstetrical Pathology with Clinical and Endocrine Relations* by Emil Novak, like its predecessor is written with the clarity characteristic of Dr. Novak's other presentations. The graphic fashion in which the subject matter is described makes it a valuable addition to the medical student's reference bookshelf. The numerous practical clinical observations will appeal both to the general practitioner and to the general surgeon. It is an essential text which should be in the laboratory of every gynecologist and pathologist.

The second edition closely follows the format of the first. The text has been revised to include pertinent new developments accrued since the first edition was published in 1938. More than 100 new illustrations have been added among which are a number of excellent photographs in color of gross specimens. Unfortunately many of the illustrations, notably the photomicrographs, do not compare in sharpness of detail with the descriptions in the accompanying text. Notable innovations have been made in the chapters on endocrinology of the menstrual cycle and in the several chapters on ovarian hormones. Discussions of stromal adenomiosis, mixed mesodermal tumors of the body of the uterus, mesonephroma of the ovary, and hypernephroid carcinoma of the ovary are welcome additions to the second edition. The several pages devoted to diagnostic methods in the chapter on carcinoma of the cervix include a practical and conservative evaluation of the vaginal smear in the diagnosis of cervical carcinoma. Cognizance is taken of the new developments in Rh incompatibilities in erythroblastosis fetalis. The inference that, in some instances, abortion or sterility may be on the basis of an Rh incompatibility is possibly somewhat premature in a text book intended for student use.

The author has admirably fulfilled his own idea of a book as expressed in the preface. He has refrained from making it exhaustive or encyclopedic yet it is sufficiently complete to be of practical value to the clinician and pathologist.

JOHN HUTTMAN

IN reviewing the twelfth edition of *Practical Physiological Chemistry* one is impressed with the re-

markable advances in the field of physiological chemistry during the ten years which have elapsed since the previous edition.

This book is familiar to most medical men for many of whom it served as a text in their first course in physiological chemistry and for whom it has since been cherished as a reference for laboratory methods. The improvement in the text with inclusion of new material which has been progressive with each succeeding edition is particularly notable in the twelfth edition. The book has been largely rewritten; the textual material preceding the experiments or methods given in each chapter has been expanded and wherever possible it presents a clear authoritative statement of present opinion which is invaluable to a student trying to gain fundamental concepts in a new field without being confused by controversial points of view.

As in the previous edition the field of physiological chemistry is covered in thirty-five chapters including a study of carbohydrates, fats, proteins, the various body tissues, digestion, blood, urine, respiratory exchange, energy metabolism, hormones, vitamins and deficiency diseases. A new chapter (Chapter 36) on antibiotics and metabolic antagonists has been added. The chemistry of the penicillins is briefly discussed and two procedures for assay, the paper disk and the serial dilution methods are given. Brief consideration is given to streptomycin, gramicidin and tyrocidine. Under metabolic antagonists is considered a group of compounds with structural similarities but capable of exerting antagonistic effects. The growth-inhibiting effect of sulfanilamide on certain bacteria is reversed by para-aminobenzoic acid. The antagonistic actions of analogues of certain amino acids as ethionine and methionine, β -2 thienylalanine and phenylalanine and of such vitamins as pyridoxamine and thiamine, glucosaccharic acid and ascorbic acid, dicumarol and vitamin K are discussed. The chapter is of more than passing interest to the physician who has not had an opportunity to follow the literature in this special field.

Several other chapters deserve special comment. The chapter on blood and lymph includes a discussion of several newer methods for fractionation of plasma proteins such as electrophoresis, various concentrations of alcohol at low temperatures and by appropriate salt concentrations. In the chapter on blood analysis the subject of photometry is presented in a clear concise manner. This is especially welcome with the adoption in most laboratories of

GYNECOLOGIC AND OBSTETRICAL PATHOLOGY WITH CLINICAL AND ENDOCRINE RELATIONS. By Emil Novak, A.B. M.D. (New York) F.A.C.S. 1941. Philadelphia and London W.B. Saunders Co. 917
PRACTICAL PHYSIOLOGICAL CHEMISTRY. By Philip B. Hawk, M.D. Bernard L. Oser, Ph.D. and William H. Sherman, M.D. 1948. Philadelphia, Toronto. The Blakiston Co. 247

gonads are ovaries or testes. In most male pseudohermaphrodites in which the individuals have lived as women the testes have been removed and in 4 or 5 of such cases including one of my own typical menopausal vasomotor symptoms have ensued. It is probably better to conserve one or both gonads for contrary to popular belief they probably exert no 'contaminating' influence on the life of the patient.

Finally and of great importance is the psychological management of such patients

which may spell the difference between later happiness or unhappiness. They can be treated simply as interesting biological or surgical problems, but as unfortunate human beings with a real cross to bear through life and with sick and tortured minds as well as malformed bodies. Only a physician with real sympathy and understanding in addition to surgical skill and biological knowledge can measure up fully to the particular requirements of patients with this type of problem.

EMIL NOVA.

The comparative anatomy and embryology of the larynx and larynx with numerous colored illustrations are depicted in a manner to command the attention of every laryngologist.

The publishers are to be commended on the excellence of the paper type and illustrations. Truly a magnificent book.

HENRY M. GOODYEAR.

THE book *A Manual of Fractures and Dislocations* by Barbara Bartlett Stimson¹ has been written with the primary purpose of serving as a handbook for medical students and general practitioners. All the essential details of fractures and dislocations are discussed in a brief understandable manner without too much theory or argumentation about disputed points. It is well illustrated with 98 drawings, showing the points discussed in the text.

In order to keep the book in its most simple form elaborate technique and detailed operative procedures are purposely omitted and just as they would only tend to confuse an individual who does not have a background of clinical fracture experience.

A large number of statistical studies are included in the book, compiled from the fracture service of the Presbyterian Hospital of New York City. These figures are very instructive and add materially to the value of the book.

This manual could be most advantageously used by senior medical students and internes during their reparatory training. It would also be an excellent addition to the library of every general practitioner.

CARLO SCUDER.

THE authors of *A Handbook for the Diagnosis of Cancer of the Uterus by the Use of the Vaginal Smear*² state that it was prepared for laboratory use. A careful study of their material and their manner of presentation indicates that not only is it superbly prepared from that standpoint, but also that it contains an excellent discussion of the entire problem of vaginal smears. Their straightforward unbiased appraisal of the value, the errors and the difficulties of the procedure appeal to the reader. The 303 photomicrographs are so well reproduced that this book might well be termed an atlas. All phases of pertinent cellular differentiation are pictured. The magnification and the sharpness of the reproductions are such that cellular detail can be readily visualized. In addition the authors have listed the various types of cells observed under individual headings and give the plate and figure numbers that portray all such cell types. This attention to detail and orderliness on the part of the authors not only makes the study by the reader easier, but also suggests that the same type of thinking is embodied in their entire work.

¹ A MANUAL OF FRACTURES AND DISLOCATIONS. By Barbara Bartlett Stimson, A.B. M.D. Med. & D. F.A.C.S. Philadelphia, Lea & Febiger, 1947.

² A HANDBOOK FOR THE DIAGNOSIS OF CANCER OF THE UTERUS BY THE USE OF THE VAGINAL SMEAR. By Olive Gates, M.D. and Skeels Warren, M.D. Baltimore: Williams & Wilkins Co., 1947.

With this handbook and atlas as a guide, an individual or a laboratory interested in adopting the vaginal smear procedure may save considerable time and effort, make more accurate diagnoses and avoid many difficulties which one would never have supposed existed from a perusal of the many reports on the subject.

JOHN I. BREWER.

THE name Rotunda Hospital, or simply The Rotunda is well known to all obstetricians throughout the world. This unique institution celebrated its two hundredth anniversary this summer in a most elaborate way and I was fortunate enough to have been invited to participate in the scientific part of the celebration. One cannot but be awed by what this old fashioned hospital has accomplished during the past two centuries. This institution has always had two aims, namely to take care of the poor and needy and to teach doctors and nurses. No one can deny that these two ambitions have been and are still being fulfilled admirably. Numerous American physicians are grateful for the training in obstetrics which they received in the Rotunda.

Since the founding of the Rotunda on March 15, 1745 by Bartholomew Morse the work was carried on by such well known names in obstetric history as Ould, Clarke, Labatt, Collins, Macan, Smyly and Tweedy. In recent years glory has been added to the Rotunda hospital by Jellett, Fitzgibbon, Solomons, Davidson and the present master, Falkiner.

Among the great contributions made for the improvement of obstetrics were the fight against puerperal sepsis, the treatment of eclampsia and most of all the emphasis on conservatism in the practice of midwifery. Not enough recognition has been given the Rotunda hospital for its struggle against puerperal fever nor to Tweedy for his contributions to the treatment of eclampsia. As the author points out, Tweedy antedated Stroganoff by one year in his emphasis on the essentials of the conservative treatment of eclampsia. In 1896, Tweedy recommended the control of convulsions by morphine, complete starvation with efficient purgation and the administration of copious fluids. He also approved of the use of stimulants and the removal of blood by venesection when indicated. Prior to the introduction of Tweedy's treatment of eclampsia at the Rotunda the mortality rate for eclampsia fluctuated between 16 and 30 per cent. During Tweedy's 7 years mastership the death rate was 8.6 per cent.

The author of *The Rotunda Hospital 1745-1945*³ O'Donel Browne has done full justice to the Rotunda, but this was to be expected. He has the Rotunda spirit in his blood for two reasons. He was an assistant master of the Rotunda and he is married to the daughter of Tweedy, who was one of the most forceful masters of the Rotunda. The book is not only an accurate historical document but also a scientific treatise. It is delightfully easy to read.

³ THE ROTUNDA HOSPITAL 1745-1945. By O'Donel T. D. Browne, M.B. M.A., M.D. (Univ. D. Sc.) F.R.C.P. (L), F.R.C.O.G. Baltimore: Williams & Wilkins Co., 1947.

the photoelectric colorimeter in place of the visual colorimeter.

The chapters dealing with intermediary metabolism have been enlarged and much improved. Modern views on the chemistry of muscle contraction are very briefly considered and must be read with the section on carbohydrate metabolism to obtain any thing like an adequate understanding of the chemical processes involved.

The text is relatively free from misstatements. Those which do occur are quite evident, as for example on page 431 it is stated that "Experimentally polycythemia may be produced in animals by the use of phenylhydrazine or the use of cobalt salts in the diet." Obviously the reference to phenylhydrazine, if correct, needs further clarification.

In conclusion, this book justly deserves the favorable acceptance accorded former editions to which it unquestionably is superior. The reviewer has found it a text well adapted for use with classes of medical students and feels it should have a place in the library of the physician. He will find in it a ready reference to many diagnostic methods and a clear presentation of current biochemical opinion. The book is well indexed. It is hoped that greater care will be taken in binding the book to its covers in future printings. Aside from this the workmanship is good, and the illustrations both numerous and well done.

CHESTER J. FARMER.

THE BOOK *The Development of Inhalation Anesthetics* by Barbara Duncum presents a careful and detailed history of inhalation anesthesia, beginning with the discoveries of Priestley and Lavoisier through the trials of Long, Newton and associates with ether and of Snow, Simpson and others with chloroform in an effort to find a perfect inhalation anesthetic and method of administration. The important anesthetic problem of the period (1846-1900) was ether versus chloroform, and the era was characterized by alternating periods in which the popularity of one or the other as an anesthetic agent predominated. The Royal Medical and Chirurgical Society of London appointed a committee to decide the question and after animal experiments on the physiological actions of ether and chloroform the committee in 1864 reported that they recommended "mixed anesthesia."

The author concerns herself chiefly with the period 1846 to 1900, and expresses the belief that the social, political, and economic conditions prevailing on the Continent, in England, and America greatly affected the evolution of anesthesia. Only in England had this period been relatively uninterrupted by social, political, and economic unrest, and only in England was the development of anesthesia in the hands of specialist anesthetists, such as John Snow. Elsewhere the surgeon had the final responsibility for the

administration of the anesthetic; he usually used the anesthesia himself and then detailed the occurrence of this necessary but otherwise important task of keeping the patient anesthetized to a medical student or some specially trained person; assistant, often one without medical training. On the side of England research into anesthetic problems was, for all practical purposes, only of academic value as there was little co-ordination or co-operation between the investigators and the surgeon in which chief interest was an insensate and relaxed patient. The result was that on the Continent and in America little real advance in anesthesia was made during this period. The author notes, however, that America after 1866 it was evident that the special anesthetist was gaining more importance and began to stay.

The introduction of the book outlines the development of inhalation anesthesia during the period under discussion and the body of the book elaborates the introductions almost completely in direct quotations from contemporary literature and original correspondence. Many reproductions of illustrations of anesthetic apparatus add to the interest of the book.

The author is a member of the Anfield Department of Anesthetics, University of Oxford, and formerly of the Wellcome Historical Medical Museum, London. These institutions are in possession of the literature and letters from which the detailed, chronological quotations which constitute the bulk of the book were taken.

This work represents much research in accumulating the appropriate material to picture methodically and interestingly the development of inhalation anesthesia during the last half of the 19th century. The fact that the book is not dull but very interesting despite the great amount of detail included, is tribute to the author's skillful tying together of contemporary literature and letters into a unified story.

WALLACE HOBBS.

In the opinion of the reviewer the authors of *His Pathology of the Ear, Nose and Throat* have presented the most valuable text available covering the entire field. The book is beautifully illustrated and direct and practical in its literature—the result of many years of pathological teaching and allied clinical experience.

The sections devoted to comparative anatomy, embryology and numerous sections of the normal and pathological findings of external, middle ear and cochlea, labyrinth, and petrous bone are superlative to the otologist. Manifestations of metabolic diseases, allergy and avitaminosis have been amply covered. The physiology and pathology of the nose and accessory sinuses are carefully described with numerous illustrations (some colored) of changes in the lining membrane of the sinuses.

HISTORIOLOGY OF THE EAR, NOSE AND THROAT. By Andrew A. Eckstein, B.S. M.D. and Dorothy Wolf, A.B. M.D. Baltimore: The Williams & Wilkins Co. 1947.

THE DEVELOPMENT OF INHALATION ANESTHESIA, WITH SPECIAL REFERENCE TO THE YEARS 1846-1900. By Barbara M. Duncum. London New York, Toronto Oxford University Press, 1947.

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SURGERY
GYNECOLOGY AND OBSTETRICS
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because of Browne's style of writing it is printed in large type on excellent paper and it is abundantly illustrated. I heartily recommend this book to all individuals interested in the history of medicine and hospitals, and to all physicians interested in obstetrics.

J. P. GREENHILL.

IN a monograph of nearly 300 pages the author of *Anatomia quirúrgica del nervio facial* reviews the surgical anatomy of the facial nerve very completely.

The major portion of the treatise is taken up with original work and essentially with descriptive anatomy based on dissections performed on 16 cadavers. In each case the five separate portions of the facial nerve are studied from its origin to its final distribution. An attempt was made to correlate the final pattern of nerve distribution with the subjects' facial type. Strict correlation seems difficult.

ANATOMIA QUIRÚRGICA DEL NERVO FACIAL. By Vicente J. Bertola. Córdoba, Argentina. Imprenta de la Universidad, 1947.

The second part of the work consists of a very brief review of parotid tumors (a clinical paper on the subject is projected for later publication) and a description of the operative procedures employed by various authors in the management of these conditions. The author's own technique also is described at length.

The text is accompanied by numerous illustrations of semidiagrammatic type. Those illustrating the dissections performed are relatively small. Those in the section of the monograph dealing with the surgical aspects of the problem are clearer however.

The introductory foreword is written by Dr. L. Finocchietto.

This volume affords a source of reference based on original work of detailed character as well as a review of the surgical approaches to exploration in the region of human anatomy where final results may be marred by injury to the facial nerve.

IRIAM T. LAMBERT

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Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

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COLLECTIVE REVIEW

THIOURACIL AND ITS ALLIES IN THE TREATMENT OF HYPERTHYROIDISM

An Experimental and Clinical Survey

GEORGE M. CURTIS M.D. F.A.C.S., and ROY E. SWENSON M.D., Columbus, Ohio

THE surgical approach designed to control hyperthyroidism has been highly satisfactory in terms of the clinical results obtained. Nevertheless, an adequate medical management is still desirable for those selected patients for whom surgical intervention is for some reason contraindicated, or in whom there remains a persistent hyperthyroidism even after a suitable thyroidectomy. The use of thiouracil and its derivatives has been suggested for such patients. These powerful goitrogenic drugs have also been found of value preoperatively and particularly in patients in whom the sufficient response to iodine has, at times, been questioned. Since these are problems which often confront the surgeon in this field, an extensive review of the experimental background together with the clinical application of thiouracil and its allies has been made and is here presented.

Cheesey, Clawson, and Webster tested the goitrogenic properties of cabbage and other Brassicace in 1928. Later Marine and his associates (134) noted that the administration of acetonitrile produced thyroid enlargement in rats. Iodine, however, prevented this goitrogenic effect. In 1941 the MacKenzies and McCollum, during their study of the effect of sulfaguandine upon the bacterial synthesis of vitamins in the rat intestine, noted

that enlargement of the thyroid gland ensued (131). Richter and Clisby, investigating the effect of bitter tasting substances in rats, found that phenylthiourea induced goiter formation. Kennedy, after studying the Brassicace, suggested that the goitrogenic effect of rapeseed was due to thiourea (112, 113).

In 1943 Astwood and his coworkers adapted a modified thiourea compound, thiouracil, which was found to have powerful metabolism inhibiting qualities (10). After preliminary animal experimentation, Astwood reported clinical improvement of 2 patients with hyperthyroidism following from 1 to 2 weeks of intensive medication with thiouracil (7).

Williams and Bissell subsequently confirmed the clinical applicability of the drug. Since the pioneer reports there have been numerous papers presenting the favorable response of hyperthyroidism to thiouracil (3, 42, 90, 99, 103, 105, 143, 163, 170, 177, 216).

Significant in the early history of thiouracil is the varied response which it received throughout the medical world. At first it was hailed as a panacea which would ultimately displace the surgical management of hyperthyroidism. This enthusiasm, however, was short lived. The pendulum soon swung and rejection even replaced the early acclaim. The widely recognized toxic effects appeared to outweigh its potential value. With the accumulation of more data there now appears to be a more moderate outlook for some thiouracil

From the Department of Research Surgery of the Ohio State University.
This investigation was aided by a grant from the Mary Chittenden Fund for Surgical Research.

vascular than the normal thyroid. The gland may even become fibrous and nodular. Hyperplasia also occurs. The acinar cells increase in number as well as in size. The lumina of the acini are frequently obliterated by the cellular overgrowth. The nuclei of the cells tend to be centrally located. The picture of tall as well as of low columnar cells, general hyperplasia, lymphoid infiltration, and colloid depletion seen as the result of thiouracil therapy closely resembles the changes frequently seen in uncontrolled exophthalmic goiter. With withdrawal of the drug is usually followed by regression of these findings (21, 75, 92, 140, 149, 187, 196). Similar microscopic appearances have been reported in rats after treatment with promizole (95).

The hyperplasia of the thyroid subsequent to thiouracil treatment appears to be due to secondary stimulation of the thyroid by an increased amount of circulating thyroid stimulating hormone elaborated by the anterior pituitary lobe. Thus hypophysectomy prevents the thyroid hypertrophy and hyperplasia normally seen after the administration of promizole (96) as well as other goitrogenic drugs (10, 187). Simultaneous administration of whole pituitary extract and goitrogenic drugs to hypophysectomized animals causes little if any stimulation of the thyroid. Resultant hyperplasia of the thyroid is greater in the normal animal when thyroid stimulating hormone and thiouracil are given simultaneously than when either is given separately (187). Griesbach, Kennedy and Purves (88) attribute the development of thyroid adenomas in rats fed seeds of the Brassicae to stimulation by thyroid stimulating hormone.

Gordon Goldsmith and Chanpiper (84) have noted that an increase in the circulating thyroid stimulating hormone, similar to that noted after subtotal thyroidectomy, is not detectable in the thiouracil treated animal. They conclude, consequently, that the thyroid is largely responsible for the removal of thyroid stimulating hormone from the blood stream. In addition, they have reported that the hyperplastic, thiouracil treated gland has an increased avidity for thyroid stimulating hormone since they found the circulating thyroid stimulating hormone was strikingly and suddenly increased when the goitrous glands were removed. That the circulating thyroid stimulating hormone is increased and that the hyperplastic gland has an avidity for it are also suggested by the work of Larson *et al* (118). These investigators noted that the thyroids of chicks treated with thiouracil have a decreased ability to trap radioactive iodine. However, when thiouracil was withdrawn, they observed that the ability of the glands to trap

radioiodine was greatly enhanced and even approached that of normal thyroids stimulated by thyroid stimulating hormone. The work of Barker (17) again suggests that thyroid stimulating hormone is capable of stimulating the thiouracil treated thyroid gland. He reports a further increase in the size of the glands of thiouracil treated rats and that such rats respond metabolically to thyroid stimulating hormone even though such responses are greatly decreased when compared to those of normal rats. It has also been observed that the pituitaries of rats fed thiouracil present the same picture as do the pituitaries of thyroidectomized rats (10, 129, 130).

Although thiouracil collects in relatively large quantities in the anterior pituitary lobe (38, 187, 212), no reports of a direct stimulatory action of the drug upon the *pars distalis* have been found in the literature surveyed.

Most investigators now agree that the principal action of the thiouracil-like drugs is to prevent the formation of thyroid hormone. This is suggested by the depletion of the colloid in the glands of thiouracil treated animals. Colloid reappears when the drug is withdrawn. The profoundly decreased metabolic response to thyroid stimulating hormone exhibited by thiouracil treated rats (17) is further evidence that thyroid hormone formation is greatly diminished. However the response of thiouracil treated rats to the administration of thyroid substance is within normal limits (16). Thiouracil treated rats respond to thyroid feeding but the response is too irregular to permit the use of such animals for the bioassay of thyroid substance (152).

The amount of thyroxine required to inhibit the production of thyroid stimulating hormone is unchanged by thiouracil therapy (89). Approximately 4.8 micrograms of thyroxine per day are required to restore to normal the metabolic rates and thyroid glands of rats previously given 0.1 per cent thiouracil in their drinking water for 2 weeks (179). Thyroxine or desiccated thyroid given with promizole completely inhibits its goitrogenic properties (95). Small doses of desiccated thyroid administered with thiouracil to patients prevented an increase in size of the goiters so treated (58). The increase in the serum globulin that occurs during thiouracil therapy as well as in hypothyroid states can be prevented or reversed by the administration of thyroid substance (120, 121). Since thyroxine or thyroid substance can prevent the goitrogenic action of the thiouracil-like drugs, it is in all probability true that these goitrogens do not interfere with the utilization of the thyroid hormone once it is formed (94, 132).

like drug less toxic than thiouracil, in the pre-operative preparation of selected patients with hyperthyroidism.

THE METABOLISM AND ACTION OF THIOURACIL

Studies pertaining to the absorption, distribution, metabolism, and excretion of thiouracil are but few. The most comprehensive work to date is that of Williams and his associates (212, 220, 221). These workers report that the drug rapidly disappears from the gastrointestinal tract. It is improbable that all of any given oral dose is absorbed from the digestive tract since gastric juice, the duodenal content, the jejunal content, as well as the staphylococcus aureus and the hemolytic streptococcus are able to inactivate the drug (212, 221). Approximately 15 per cent of the drug given orally is destroyed in the digestive tract (38). Within an hour 50 per cent of a single oral dose is absorbed while a maximum blood level is obtained within from 15 to 30 minutes. Repeated small doses of 0.2 gram every fourth hour maintain blood levels of from 2.5 to 3.0 milligrams per 100 cubic centimeters. When such amounts are given for 3 days and then stopped, the blood concentration falls abruptly and the blood is clear of the drug within 48 hours (212, 221). In the blood stream, thiouracil enters both the red and white cells, but the concentration is greatest in the white cells (126, 127, 187, 212, 221). It is present in high concentration in the serum (221).

Studies by Williamson and his associates suggest that thiourea is readily absorbed from wounds (223). These workers have pointed out that many ointments containing sulfonamides, peroxides, and tannic acid also contain thiourea that has been added as an antioxidant. They observed that when 100 milligrams of ointments containing 1 per cent and 10 per cent thiourea were applied weekly to experimental wounds on rats, thyroid hyperplasia and a great diminution in the amount of stored colloid ensued.

Thiouracil enters most organs and body fluids (187). After administration it is present in large quantities in the thyroid, bone marrow, ovaries, liver and pituitary gland. Smaller amounts have been demonstrated in the kidneys, adrenals, pancreas, brain, heart, lungs, testes, prostate, spleen, and striated muscle. The drug has been found in edema fluid, cerebrospinal fluid, pleural fluid, ascitic fluid, pericardial fluid, urine, and in human milk. The concentration in human milk is 3 times that of whole blood (38, 187, 212, 221). Transfer across the placenta also occurs, and the action of the drug upon the fetal thyroid has been demonstrated (39, 80).

The method or methods involved in the breakdown of thiouracil and its allies in the new organism are obscure. When thiouracil is incubated with liver tissue, 33 per cent is destroyed within 2 hours (212). However, the amount of activation appears to be inversely proportional to the amount of liver tissue present.

The response to a given dose of thiouracil in a rat is greatly intensified after subtotal hepatectomy (212). A similar study to determine the effect of thiouracil after subtotal hepatectomy would be of great interest.

Thiouracil is rapidly excreted in the urine. With 1.0 gram of thiouracil is given orally to a fasting patient, 75 per cent is excreted in 10 hours and 90 per cent within 24 hours (41). The amount of thiouracil excreted as such, however, is variable, but probably varies from 30 per cent (38) to 50 per cent (212, 221). Seventy-five per cent of an oral dose of thiourea has been recovered in the urine of the dog (162). When from 0.1 to 0.3 gram of thiouracil (a common preliminary dose) is given to a normal fasting man, urinary excretion is maximal during the second hour and then gradually decreases. However, as the total daily dosage increases, the percentage excreted per day decreases (187, 212). Cytosine and uracil are detectable in the urine of dogs fed thiouracil (187). Additional studies pertaining to the metabolism of the thiouracil-like drugs are necessary before any comprehensive understanding of their absorption, distribution, and excretion can be reached.

The ability of the goitrogenic drugs to cause thyroid hypofunction is now generally recognized. Depression of the basal metabolic rate in rats fed thiouracil has been reported frequently (17, 14, 152, 179, 192). Growth retardation as well as depression of the basal metabolic rate in rats has been reported after promizole (95) and thiouracil feeding (80). Muhrer and Hogan observed abnormal fat deposition and retarded growth in rats fed thiouracil. Inhibition of amphibian development has also been described (84, 85, 157). Thiouracil treated rats are more able to withstand reduced oxygen tensions than are normal animals (81, 86). Lowering of the basal metabolism in hyperthyroid patients has been reported in almost every paper discussing such instances. A few of these reports may be mentioned (19, 22, 24, 28, 32, 53, 66, 75, 87, 90, 104, 142, 154, 164, 165, 166, 177, 189, 211, 217). Myxedema also occurs after thiouracil therapy (3, 32, 143, 151, 170).

Thiouracil induced changes in the thyroid glands of animals and human beings are strikingly similar. The hypertrophied thyroid, increasing in both size and weight, becomes soft, friable, and more

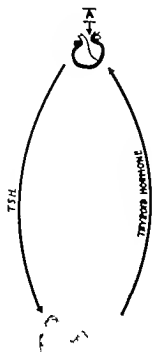


Fig. 1. The normal reciprocal relationship between the anterior pituitary lobe and the thyroid gland. Thyrotrophin appears to govern the formation and release of the thyroid hormone. The thyroid iodine is normally 2 milligrams per gram of dried gland. The total blood iodine is 4.5 ± 1.5 micrograms per cent. The acetone-insoluble blood iodine is 0.9 ± 0.3 micrograms per cent. The urinary iodine depends upon the intake as well as the geographic region.

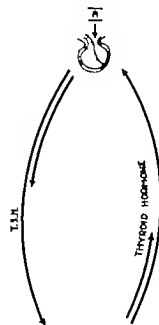
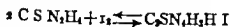


Fig. 2. Graves disease—untreated. The normal reciprocal relationship between the anterior pituitary lobe and the thyroid gland is broken by some unknown mechanism. Thyrotrophin appears to accelerate thyroid hormone formation and its release into the circulatory system. The thyroid iodine is diminished (0.5 milligram per gram of dried gland). The total blood iodine and the protein bound blood iodine are increased. The urinary iodine is increased.

goitrogenic groups may interrupt the formation of thyroid hormone at different stages (194)

Campbell and Landgrebe reported that thiourea has a striking affinity for iodine. On the basis of the reaction



they state that 1.4 milligrams of thiourea will combine with 1.63 milligrams of iodine. The reaction is reversible if the concentration of thiourea is above 0.04 per cent. Such a reaction could readily occur when the blood concentration of thiourea is at therapeutic levels. Similar reactions can probably occur with other easily oxidizable goitrogens. This becomes more significant when one considers that the total blood iodine normally averages about 230 micrograms. Salter, Cortell, and McKay (192) have recently reported that thyroid protein continues to be formed by the thiouracil treated thyroid gland. This would favor the hypothesis that the goitrogenic drugs compete with the thyroid cells for iodine. However if the thiouracil-like drugs block only the iodination of the thyroid protein and do not affect the metabolism of des-

iodothyroglobulin they are remarkably specific. Extensive further studies are necessary before the exact action of the thiouracil-like drugs upon the thyroid cell will be definitely known.

Figure 1 presents diagrammatically the normal anterior pituitary thyroid relationship. This appears to be governed by some unknown factor.

A corticothalamic mechanisms may play a role. This aspect of the physiologic relation between the thyroid and anterior pituitary lobe is but poorly understood. There is recent evidence that thyroid stimulating hormone is intimately related to the storage and release of thyroid hormone from the follicles (62, 63, 110, 118, 209).

Figure 2 presents the pathologic physiology of untreated Graves disease. The normal reciprocal relationship of the anterior pituitary lobe and thyroid is presumably broken by the action of some unknown mechanism. As a result the anterior pituitary lobe is stimulated to produce increased thyroid stimulating hormone. Under these circumstances the thyroid is greatly stimulated and manufactures increased amounts of hormone yet apparently cannot manufacture

Barker (15) has made the interesting observation that thiouracil treated rats do not respond metabolically to dinitroresol as do normal rats. He suggested that either the thyroid hormone must be present before a metabolic response to dinitroresol is secured or that dinitroresol acts through the thyroid cells.

The simultaneous administration of iodine with the thiouracil-like drugs does not prevent their goitrogenic action (92 187 192). Larson and his associates (118, 119) have reported that the ability of the chick's thyroid to take up radioactive iodine is greatly decreased within 1 hour of the administration of thiouracil. Chagas, De Robertis, and Couceiro find that the amount of iodine in the thyroid follicle is decreased by thiourea. The alveolar colloid produced under the influence of the goitrogenic drugs is poor in iodine (7 72 98, 178). The thyroidal iodine of rats is severely depleted by administering 150 milligrams of thiouracil per day in food containing 13 micrograms of iodine (192). Thiouracil has been shown to interfere with the incorporation of iodine into thyroxine and diiodotyrosine both in vitro and in vivo (71 73 187). The exact point at which the formation of thyroglobulin is checked has not been established (178). In patients treated with thiouracil, the thyroidal organic and inorganic iodine content diminishes, the circulating protein-bound iodine decreases and the total blood iodine concentration decreases. The urinary iodine excretion first rises and then falls as the body is depleted of iodine. From evidence such as this, it has been concluded that the thiouracil-like drugs prevent the synthesis of the thyroid hormone by the thyroid gland.

That the thiouracil-like goitrogens interfere with some cellular oxidation mechanism is strongly suggested by the work of De Robertis and Goncalves (61). These authors have ascertained the normal oxidation-reduction potential of normal thyroid cells and colloid to be $+0.050$ and -0.200 volts, respectively. Stimulation with thyroid stimulating hormone increases the potential of the colloid to the same level as that of the cells. These authors have also noted that the administration of thiourea both in vivo and in vitro reduces the oxidation-reduction potential of the cells and colloid of thyroid stimulating hormone stimulated thyroids to -0.200 volts. In addition the goitrogenic activity of sulfonamide compounds depends upon the presence in the molecule of a free aromatic amino group or a free aromatic hydroxyl group both of which are easily oxidized (203). Carboxyl and sulfonamide radicals bear but little relation to antithyroid activity.

Astwood, Blasel and Hughes (9) have studied the goitrogenic compounds and have observed that the 2 types of chemical structure associated with antithyroid activity are (1) the thiocarbonyl group, and (2) the aminobenzene group. These, too, are easily oxidizable. The chemical structure of the sulfonamides differs greatly from that of thiouracils and it is probable that the site involved in the mechanism of thyroid inhibition is different (2).

As yet the exact mechanisms by which the thiouracil-like drugs inhibit the formation of thyroid hormone are uncertain. The main hypotheses maintain that the drugs inhibit some enzyme system or systems responsible for the formation of iodination of thyroid protein, or that the drugs themselves combine with iodine in such a way that it is no longer available to the cells of the thyroid.

It is probable that more than one enzyme system is involved in the complicated process of forming the thyroid hormone. The cytochrome oxidase and peroxidase systems were perhaps the first to be implicated (60). Thiouracil was shown to be capable of inhibiting peroxidase (157). Schachner, Franklin, and Chalkoff have reported that the in vitro formation of thyroxine and diiodotyrosine is inhibited by KCN, hydrogen sulfide, cobalt, and NaN_3 . Since only 2 enzyme systems, the cytochrome oxidase and the polyphenol oxidase, are inhibited by all of these inhibitor substances, and since polyphenol oxidase is not present in the thyroid, these investigators concluded that the cytochrome oxidase system was intimately related to the in vitro formation of the thyroid hormone. Paschke and his coworkers (169 171) were able to demonstrate that cytochrome oxidase activity of the thyroid in vivo could be decreased 51-63 per cent by 0.005 molar solutions of thiouracil, but could not inhibit the activity of this enzyme in kidney slices and in bone marrow where it is of the same magnitude as in the thyroid. They also reported that the cytochrome oxidase activity of the thyroid glands of rats fed 0.05 per cent thiouracil in their drinking water for 3 weeks was subnormal. However, Lerner and Chalkoff were not able to inhibit cytochrome oxidase activity with thiouracil. Thiouracil has been found readily to inhibit the in vitro formation of melanin by the enzyme tyrosinase (168) but it exerts no inhibitory action upon xanthine oxidase or inosinephosphate dehydrogenase (187). Since the goitrogenic activity of the cyanoide compounds can be prevented by the administration of iodine, while that of the thiouracil-like compounds cannot (185) it appears that these

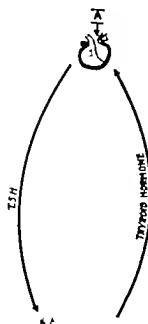


Fig 1 The normal reciprocal relationship between the anterior pituitary lobe and the thyroid gland. Thyrotropin appears to govern the formation and release of the thyroid hormone. The thyroid iodine is normally 5 milligrams per gram of dried gland. The total blood iodine is 4.3 ± 1.2 micrograms per cent. The acetone-insoluble blood iodine is 0.9 ± 0.3 micrograms per cent. The urinary iodine depends upon the intake as well as the geographic region

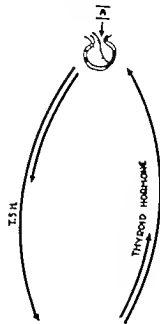
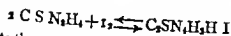


Fig 2 Graves disease—untreated. The normal reciprocal relationship between the anterior pituitary lobe and the thyroid gland is broken by some unknown mechanism. Thyrotropin appears to accelerate thyroid hormone formation and its release into the circulatory system. The thyroid iodine is diminished (0.3 milligram per gram of dried gland). The total blood iodine and the protein bound blood iodine are increased. The urinary iodine is increased.

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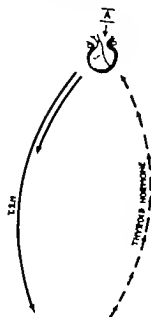


Fig. 3. Graves' disease—iodine treated. The normal reciprocal relationship between the anterior pituitary lobe and the thyroid gland is broken by some unknown mechanism. The inorganic thyroid iodine and the organic thyroid iodine are increased. The inorganic blood iodine is increased, but the protein-bound blood iodine decreases even to normal limits. The urinary iodine is greatly increased. The iodine acts in some way to block hormone from the gland, but the

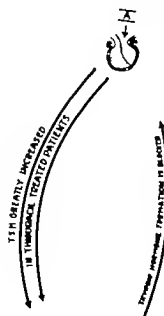


Fig. 4. Graves' disease—thiouracil treated. The relationship between the anterior pituitary lobe and the thyroid gland is further interrupted as the formation of thyroid hormone is blocked. The thyroid gland becomes hyperplastic and the thyroid iodine greatly decreases. The total blood iodine and the protein bound blood iodine decrease. The urinary iodine first increases and then diminishes.

enough to inhibit the production of thyrotrophin. The unknown mechanism stimulating the anterior pituitary lobe appears stronger than the greatly increased circulating thyroid hormone. Thyroidal iodine decreases as the circulating protein-bound iodine rises, and as this occurs the urinary excretion of iodine increases. The patient then goes into a negative iodine balance, unless sufficient supplemental iodine is given.

Figure 3 presents diagrammatically the action of iodine in Graves disease. The increased iodine does not appear to alter the fundamental pathologic physiology of Graves disease, yet it does correct the negative iodine balance. The theory regarding the mode of action of the administered iodine is still controversial, but it is probable that this action prevents the increased release of thyroid hormone into the circulation (63) for a variable period of time. Clinically this is evidenced by the induced "iodine remission" from active Graves disease. Iodine therapy greatly increases the thyroidal iodine, decreases the circulating protein-bound iodine, and results in great storage of iodine (54).

Figure 4 presents diagrammatically the effects of treating Graves disease with thiouracil. The fundamental pathologic physiology remains. As thiouracil is given, the production of thyroid hormone diminishes and eventually ceases. The anterior pituitary lobe thus loses this stimulation with a resultant production of increased thyroid stimulating hormone. Subsequently the thyroid gland becomes even more hyperplastic. Since the ability of the thyroid to take up iodine is greatly diminished by the action of thiouracil, the thyroidal iodine, already decreased by the disease, is further decreased. The circulating protein-bound and inorganic iodine decrease as the urinary iodine first rises and then falls as the organism, already greatly depleted of iodine, is still further depleted.

THE TOXICITY OF THIOURACIL

Toxic reactions, directly attributable to the use of thiouracil, have been reported in from 6.7 per cent (21) to 18 per cent (75) of the cases of hyperthyroidism so treated. The percentage of toxic reactions which may be expected in patients treated with thiouracil is approximately 13.1 as reported by Van Winkle and his associates who analyzed 5,745 cases collected from various clinics. Similar figures of 14.4 (138), 12 (142) and 14.5 per cent (218) have been reported.

Reports of toxic reactions due to simple overdose are few. However reports of toxicity due to idiosyncrasy are increasing at a rapid pace (12, 13, 68, 77, 78, 224, 235, 255, 273, 297, 305, 314,

325). Hypersensitivity reactions are the most dangerous. Most feared is the depression of the bone marrow resulting in diminution of the leucocytes and particularly of the granulocytes.

Various writers have presented different criteria as to what constitutes leucopenia and granulocytopenia. This has made evaluation of the available data difficult. It is suggested that Van Winkle's definitions of leucopenia and granulocytopenia be generally adopted in order to avoid confusion in the further evaluation of goitrogenic drugs. Leucopenia (215) is defined as that state in which the leucocytes number 4,000 or less, and the differential count is normal, while the patient presents no subjective symptoms. Similarly granulocytopenia is defined as that state in which the white blood cells number 4,000 or less, while the differential count reveals a particular decrease in the granulocytes (215). Others, however, have thought that once the differential count shows a decrease in the granulocytes, the diagnosis of granulocytopenia should be made and the drug stopped before the clinical signs of fever, malaise, and pharyngitis become evident. If Van Winkle's criteria were to be generally adopted and all cases so reported, it would appear that the incidence of granulocytopenia induced by thiouracil should increase.

Resultant leucopenia, neutropenia, granulocytopenia, and agranulocytosis are commonly reported. These reactions vary in degree from a slight shift to the left in the entire leucocytic series, that returns to normal even if the drug is not discontinued (224, 226) to severe and even fatal agranulocytosis (68, 122, 155, 173, 197). Many reactions varying between these two extremes have been observed (19, 21, 22, 53, 74, 75, 117, 134, 139, 142, 143, 164, 165, 174, 177, 278, 281, 301, 317, 318, 324).

A leucopenia existing before thiouracil therapy may even disappear during treatment (143), or the drug may convert it into a severe agranulocytosis (318).

Leucopenia has an over-all incidence of approximately 4 per cent (155, 215). According to Van Winkle it accounts for 30 per cent of all toxic reactions, and 23 per cent of the patients with this condition develop agranulocytosis. Gabrielle, Kert, and Soffer (75) report that 9 of 51 patients had a depression of the white cells and of these 6 developed agranulocytosis. Agranulocytosis has been reported after as little as 7 days of treatment (305) after a year of continuous treatment (215) and 6 months after the treatment was stopped (215). The most frequent time for agranulocytosis to develop is between the fourth and eighth weeks

suddenly precipitated within 3 hours when a small dose of the drug was again given. Shrinkage of the spleen in experimental animals to one half or even to one fourth of its normal size has been reported by Baumann and Marine (25). Meuthner and Anderson (149) reported an enlarged thymus which they attributed to thiouracil treatment.

Waller and Charipper established normal values for the electrocardiogram of the rat and then studied the changes induced by thyroidectomy and thiourea treatment. These workers noted an increase in conduction time in thiourea treated animals and a decrease in the conduction time in thyroidectomized animals. Both thyroidectomized and thiourea treated animals showed a decrease in heart rate, but this was more pronounced in the thiourea treated rats in which the rate decreased to two-thirds of the normal i.e. the rate decrease paralleled the increase in conduction time noted in the thyroidectomized animals. Both groups showed a decrease in the amplitude of the T waves, but this was greater in the thiourea treated group.

Rose and McConnell observed a gradual decrease in the cardiac output of patients receiving the drug. Bain reported the case of a patient with hyperthyroidism treated with thiouracil in whom fever profound bradycardia complete atrioventricular dissociation pericarditis, and slight jaundice developed. These alarming developments subsided when the drug was stopped. The complete heart block reported by Bain becomes more significant when considered in the light of the greatly increased conduction time reported by Waller and Charipper.

The development of the lesions of periarteritis nodosa has been reported in both man and animals given thiouracil. Marine and Baumann (133) noted the development of these lesions in rats fed thiouracil for 23, 31, 2, and 365 days. The lesions developed along the path of absorption of the drug from the gut. Such hypersensitivity may be induced by specific thiouracil protein conjugates formed in the gut, or their hydrolytic products which are then absorbed through the lymphatics. Gibson and Quinlan (78) reported the case of a hyperthyroid woman who received 31.5 grams of thiouracil in 35 days. She first complained of joint pain and numbness of the extremities. Jaundice leucoderma, and conjunctivitis then developed. The vibratory sense and ankle jerks were lost and coma and death supervened. Autopsy revealed paraneuritis characterized by intense fibrinoid degeneration and perivascular cuffs of inflammatory cells. The

arteritis was most evident in the liver spleen thyroid adrenals kidney and heart.

Similarly Rich (185) reported the case of a patient with thyrotoxicosis treated with Lugol's solution who suddenly developed fever. Potassium iodide was then administered and the patient developed a high fever skin rash joint pains, lymphadenopathy and splenomegaly. Autopsy revealed periarteritis nodosa lesions in the liver spleen pancreas kidneys testes, and prostate. Hypersensitivity to iodine has long been known, yet idiosyncratic reactions to iodine are rare in hyperthyroid patients.

Knab has used thiouracil in the treatment of angina pectoris on the same basis that total thyroidectomy was formerly done for selected patients with the anginal syndrome. Thyroidectomy decreases the amount of circulating thyroid hormone and thus diminishes the sensitivity of the heart to epinephrine. Experimentally a greater amount of epinephrine than usual is required to cause cardiac death in rats treated with thiouracil and conversely a decreased amount of epinephrine is required to cause death in thyroxine treated rats (181) (187). However thiouracil administration also increases the production of adrenotropic hormone by the anterior pituitary lobe (187). The mechanism responsible for this effect is as yet obscure. Raab reported that 8 of 10 patients so treated were benefited. Ben Asher has noted good results in 7 of 8 patients treated but his best result was in a patient with an associated basal metabolic rate of plus 24 per cent.

Purpuric reactions (66, 218) have been noted. They may be due to an increase in capillary permeability or to a decrease in the number of thrombocytes. The latter has been reported (19).

Basophilic hyperplasia and eosinophilic hypoplasia of the anterior pituitary lobe, similar to that subsequent to thyroidectomy are induced by thiouracil and other goitrogenic drugs (89, 96, 187, 192). The production of the gonadotropic and adrenotropic hormones is increased (120, 187).

Liver damage caused by thiouracil has been reported to vary from a slight jaundice to acute yellow atrophy. Jaundice (13, 19, 52, 77, 151, 198, 201, 205, 217) toxic hepatitis (147, 150) and acute yellow atrophy (188) have all been observed. Meuthner and Anderson have noted jaundice clinically with central necrosis and peripheral degeneration of the hepatic lobules at necropsy (149). However their observations are difficult to evaluate, since their patient died in a postoperative crisis. The mechanism of liver damage by thiouracil is obscure. The cholinesterase activity of liver slices treated with thiouracil is twice normal yet

However we have found no studies pertaining to the duration of life of the granulocytes of patients treated with thiouracil. Thiouracil may affect the release of granulocytes from the bone marrow as well as their maturation (127)

Repeated frequent observations of the patient as well as of his blood cells have been advocated by almost every writer who has reported a series of cases of hyperthyroidism treated with thiouracil. Even this has not prevented the development of agranulocytosis. Once it develops, all agree that the drug should be immediately withdrawn and steps taken to stimulate the bone marrow and to ward off infection. An ensuing infection may precipitate a thyroid crisis (205). Penicillin appears to be the best agent available for combating infection and its use has been recommended (218) as has the simultaneous use of whole blood transfusions (190). Because of the known ability of the sulfonamide drugs to produce idiosyncratic reactions and depression of the bone marrow it is suggested that they be used in the treatment of thiouracil induced agranulocytosis only when the superimposed infection is resistant to penicillin therapy. The use of pyridoxine hydrochloride (43, 70, 140) and of pentose nucleotide has been reported (135).

The administration of liver and folic acid simultaneously with thiouracil, in order to prevent the development of agranulocytosis, has been commented upon both favorably (124) and unfavorably (218) as has the concurrent use of liver alone with the thiouracil-like drugs (125, 136). Daft and his associates gave the L. casei factor to rats and noted minimal protection against the development of agranulocytosis when thiouracil was given. Thyroxine was also ineffective. Palmer (167) has reported that cevitamic acid counteracts the effect of thiouracil upon the bone marrow. Lahey and associates (217) advocate the combined use of penicillin, pyridoxine, and folic acid in the treatment of agranulocytosis. This feared toxic reaction with a reported fatality rate varying from 14 per cent (155) to 26 per cent (225) and even 50 per cent (117) certainly demands the best treatment in our therapeutic armamentarium. Limard and Ricewaxer (127) however have emphasized that the key to recovery is not primarily the treatment directed against the agranulocytosis, but rather the amount of bone marrow damage that has occurred. They have advocated that bone marrow studies be made as an index of prognosis.

Mild, transient anemia has also been observed in rats fed thiouracil (55, 208, 210) nevertheless, bone marrow studies reveal little or no depression of the erythroid series. Warren, who produced

erythroid hyperplasia of the bone marrow by intraperitoneal injections of acetylphenylhydrazine has reported that the respiration of young erythrocytes is relatively unaffected by thiouracil. One report of severe thiouracil induced anemia in 2 patients receiving the drug was found in the literature reviewed (142).

Deaths have been reported by various authors (27, 52, 68, 75, 77, 100, 109, 124, 155, 215, 216). Cope, speaking before the American Association for the Study of Goiter on June 22, 1948, placed the number of deaths due to thiouracil at 77. We can add 1 more.

Other severe reactions due to idiosyncrasy are drug fever (1, 4, 74, 141) and dermatitis (74, 115, 143, 198). Drug fever has an over-all incidence of 2.7 per cent and dermatitis occurs in approximately 3.3 per cent of the patients treated with thiouracil (225). Drug fever with a sudden increase in temperature usually develops after from 10 to 18 days of treatment (138). The temperature falls to normal when the drug is stopped and is most apt to rise again if small amounts of the drug are subsequently given. Purpura (66, 218), maculopapular rashes, macular rashes, urticaria, pruritis and scleroderma (117) have been reported following the use of thiouracil. Both drug fever and dermatitis indicate sensitization of the patient and demand that the thiouracil be stopped lest further reaction occur. It appears probable that thiouracil combines in some way with the proteins of the blood (218) and that antibodies against this combination are formed. This is a likely basis for the sensitivity reactions that are reported.

Myxedema is also one of the complications resulting from continued thiouracil therapy (3, 143, 170) but is reversible when the drug is withdrawn. Administration of thiouracil to rats from the time of birth results in retardation of growth, arrested development, mild anemia, and changes similar to those seen in cretinism (102).

Swelling of the submaxillary glands is a frequent development in patients receiving thiouracil (52, 77, 117, 164, 201, 217, 218). Nummy (164) has also reported enlargement of the parotid glands. Williams and associates (218) have reported general lymphadenopathy. That the adenitis, almost specific for the salivary glands, is an idiosyncratic reaction is suggested by the occurrence of the Mikulicz syndrome in a case reported by Bishop and Rawson. This patient developed fever and swelling of the salivary and lacrimal glands. Bacterial cultures were negative, and there was no response to chemotherapy while thiouracil was given. The condition improved remarkably within 48 hours after the drug was stopped. Recurrence was

the in vitro respiration of liver slices is normal (187). In view of the reports of liver damage caution is advised when giving thiouracil to hyperthyroid patients who already show liver damage as evidenced by diminished liver function tests.

Baummann and Marine (25, 26) reported extensive observations pertaining to the effect of thiouracil upon the adrenal cortex of the rat. They noted that a reduction of the cortex to half of the normal size occurs by the third or fourth month of treatment. All 3 layers of the cortex were decreased in size. Dalton and associates have made similar observations. Atrophy of the human adrenal cortex after death from thiouracil has been reported (149). However no changes of the oxygen uptake of the adrenal slices occur in vitro and the blood chemistry changes of adrenal cortical disease do not develop (187). It has been stated by Baummann and Marine that recovery of the cortex later occurs even if the drug is continued. An infection resulted in cortical enlargement in the presence of an atrophy previously induced by thiouracil. The relation of an increased amount of adrenotropic hormone (187) to these changes is not clear. In vitro concentrations of thiourea as low as 6×10^3 to 10^4 molar inhibit the stimulatory effect of from 2 to 10 micrograms of epinephrine per liter of glucose tyrode bath on the gut and rabbit uterus. The addition of plasma or red blood cells to the tyrode bath prevents this inhibition. However doses of from 10 to 200 milligrams have no effect upon the autonomic mechanisms of the intact rat (64, 187).

Thiourea appears in mother's milk and also passes the placental barrier (80, 102, 197). Goldsmith, Gordon and Chanpper (80) have given pregnant rats 0.5 per cent thiourea in drinking water for from 1 to 15 days before parturition. They observed that hyperplasia of the fetal thyroid and retarded growth were transient. However the 15 day period of treatment was probably too short to deplete the maternal thyroids of thyroid hormone. These same observers (85) have noted that thiourea inhibits the metamorphosis of *Rana pipiens* larvae and also inhibits the stimulatory effect of thyroid stimulating hormone upon the larvae.

Chu has reported that thyroid hormone is necessary for normal gestation in the rabbit, and has demonstrated that embryos of thyroidectomized rabbits are resorbed or aborted, and that the administration of thyroid substance permits normal gestation and parturition to occur.

Davis and Forbes have reported the sudden death of a 21 year old woman during the sixth month of gestation. She had been treated with thiouracil before and throughout pregnancy and was on a maintenance dose of 200 milligrams daily.

No sensitivity was mentioned. The lobes of the fetal thyroid were hyperplastic and showed no evidence of colloid storage. Williams (214) observed no ill effects in 3 infants whose mothers had received thiouracil during the period of gestation.

Thiouracil has been advocated as a measure to control hyperthyroidism during pregnancy (25, 27, 31, 34, 132, 166, 176, 214). However, controlled experiments in which the effects of thiouracil given to animals and human beings during pregnancy were studied are too few. Until such experiences are reported and evaluated, the advisability of prolonged thiouracil treatment during pregnancy remains questionable.

Goldsmith and Harnly (83) have noted that concentrations of from 10 to 125 milligrams of thiourea per 100 cubic centimeters of water are strikingly lethal for the larvae of the ebony black, and sooty mutants of *Drosophila melanogaster*. Fifteen milligrams per 100 cubic centimeters produce 100 per cent mortality of the wild larvae. Goldsmith and Harnly even suggested the use of thiourea as an insecticide.

Deposition of thiouracil in the urinary tract of experimental animals has been reported (25, 207). McGavack and Vogel (144) found renal calculi in rats given 5-methyl and 5,6-dimethylthiouracil. Barr and Shorr (19), Astwood (2) and Williams *et al* (218) have reported hematuria in patients receiving thiouracil. Paschiks and his associates (171) observed that the cytochrome oxidase activity of kidney slices in vitro is not depressed by 0.002 and 0.01 molar concentrations of thiouracil.

Varied disturbances of the central nervous system during thiouracil therapy have been noted. Atkin observed delusional psychoses. Leys reported euphoria after methyl thiouracil, and Hammer has noted somnolence and mental confusion following thiouracil. Delusions and a persecution complex exhibited by a patient receiving the drug were studied by Pearson. Cessation of the drug ameliorated the symptoms, and further dosage precipitated the same psychosis. Loss of the vibratory sense, loss of the ankle jerks, and then coma were observed in 1 patient by Gibson and Quinlan. Haines and Keating, and Hammer have reported myoclonic muscular contractions and muscular twitchings. Cannon observed improvement in anxiety states after thiouracil therapy but the improvement was greatest when there was an associated elevation of the basal metabolic rate. Riker and Wescoe citing the work of Ellis and Root state that the cholinesterase activity of brain slices taken from rats that had received thiouracil is within normal limits. The altered physiology responsible for these central nervous system symp-

toms is obscure. No studies of the brain metabolism in animals receiving the drug were found in the literature reviewed.

Unobserved and less apparent dangers of the thiouracil like drugs are suggested by Bielschow sky who produced cancer of the thyroid gland in rats with the combined medication of 2-acetylaminofluorene and allylthiourea (31). 2 Acetylaminofluorene is a carcinogen which heretofore has not been known to affect the thyroid gland yet when used in combination with allylthiourea, which alone produced hyperplasia of the thyroid follicle cells, cancer results. Purves and Griesbach have reported the development of carcinoma of the thyroid in 2 of 30 rats after prolonged treatment with thiourea. Metastases were found in the thyroid veins and also in the lungs. These authors attribute the malignancy to prolonged stimulation of the thyroid cells by thyrotropin. These reports call into question the safety of the clinical application of the thiourea compounds, particularly in patients with nodular goiter in whom the threat of malignancy is already present in varying degrees. Many reports discussing the various toxic responses are available (19 21 53 75 77 87 142 155 164, 174, 201 211 218 219 225).

A classified list of toxic responses gleaned from the literature follows

TOXIC RESPONSES

Bone Marrow Effects

1. Agranulocytosis
2. Anemia
3. Granulocytopenia
4. Leucopenia
5. Neutropenia
6. Thrombocytopenia

Cardiovascular Effects

1. Heart block
2. ECG changes
3. Pericarditis nodosa
4. Pericarditis
5. Purpura
6. Flushing

Central Nervous System Effects

1. Coma
2. Confusion states
3. Delirium
4. Dizziness
5. Headache
6. Loss of ankle jerks
7. Loss of vibratory sense
8. Nausea
9. Vomiting
10. Persecution complexes
11. Various psychoses

Gastrointestinal Effects

1. Nausea
2. Vomiting
3. Diarrhea
4. Abdominal pain

Liver Effects

1. Acute yellow atrophy
2. Degeneration of hepatic lobules
3. Hepatitis
4. Jaundice

Lymphatic Effects

1. Enlarged lymph nodes
2. Enlarged salivary glands
3. Leg edema
4. Myxedema
5. Decreased size of spleen
6. Enlargement of thymus

Miscellaneous Effects

1. Arthritis
2. Choking
3. Dryness of the mouth
4. Fatigue
5. Hematuria
6. Fever
7. Joint pains
8. Muscular pains
9. Pharyngitis
10. Thirst

Ophthalmic Effects

1. Chemosis
2. Conjunctivitis
3. Decreased corneal reflex
4. Increased corneal reflex
5. Photophobia

Effects upon the Skin

1. Leukoderma
2. Macular rashes
3. Maculopapular rashes
4. Morbilliform rashes
5. Purpura
6. Pruritus
7. Urticaria
8. Urticaria with pruritus
9. Painful subcutaneous swellings
10. Scleroderma

CLINICAL EVALUATION

Many experienced observers have carefully studied the clinical applications of thiouracil. Additional papers confirming its ability to decrease the basal metabolic rate are available (18, 37 38 53 56 65, 67 69 77 79 92 108 122 140 152 158 159 160 161, 165 181 183 184). Leiter *et al* determined the effect of thiouracil upon the hyperthyroidism resultant from functioning metastases of thyroid carcinoma. In one of their patients the cervical thyroid tissue had been radically extirpated. Activity of the metastases in this, as well as in another patient, was demonstrated by radioiodine studies. The administration of thiouracil caused a decrease in the basal metabolic rate, and an increase in the blood cholesterol and in the body weight. The urinary excretion of radioactive iodine was doubled during thiouracil therapy. Recurrence of the hyperthyroidism occurred when the drug was withdrawn. No effect upon the growth of the metastases was reported.

Iodine administration previous to thiouracil therapy causes a slower response to the drug (19 92 151 167 187 214, 217) but does not prevent its characteristic goitrogenic action (58). Some depletion of the thyroid hormone already manufactured and stored appears to occur before

its action becomes evident clinically since thiouracil, soon after its administration decreases the ability of the thyroid to take up iodine (119).

Initially 0.6 grams in 3 divided doses of 0.2 gram each are usually given daily until the basal metabolic rate has fallen to normal limits. Then maintenance doses of from 0.1 to 0.2 gram per day are continued (21 22 29 33 53 56, 69 101 117 151 155 211 217 225). Therapeutic blood levels on dosages such as this vary from 1 to 6 milligrams per 100 cubic centimeters. One day of elevation of the basal metabolic rate for each percent of the basal metabolic rate (21 117). However there is usually an initial lag period varying from 2 to 3 weeks before the basal metabolic rate falls toward normal (52 75). Six weeks of treatment may be required before the basal metabolic rate becomes normal (217). However the response to the drug is slower if the disease has been of long duration (87). A basal metabolic rate

that is high initially may fall rapidly during thiouracil therapy while a low one may fall quite slowly (174). The basal metabolic rate also falls more rapidly in young people (211). Early hyperthyroidism responds more rapidly than chronic. The hyperthyroidism of diffuse hyperplastic goiter responds more favorably than does that of toxic nodular goiter (29, 167, 183, 187). In a relatively small number of patients there is no response to the drug (51, 52, 66, 147, 187, 189). Poate failed to secure a remission of the hyperthyroidism caused by a functioning fetal adenoma with thiouracil therapy.

Other changes in addition to the decreased basal metabolic rate also indicate a reduction in metabolic activity. The blood cholesterol rises (21, 52, 141, 142, 148, 211) and there is a more or less straight line relationship between the elevation of the blood cholesterol and the falling basal metabolic rate (141). It has also been observed that the blood cholesterol may rise to myxedematous levels before the basal metabolic rate decreases to similar levels (16). The protein bound iodine of the blood decreases to normal (117) and its fall may be more rapid than that of the basal metabolic rate (211, 214). These findings we are able to confirm. The excretion of calcium, nitrogen, phosphorus, and creatinine is decreased toward normal limits (19). An increase in the plasma or serum globulin occurs even though the total blood protein may remain unaltered (120, 121). An increase in the plasma chloride and a decrease in the plasma carbon dioxide combining power have also been reported (93). The effects of thiouracil upon the blood magnesium partitions are controversial (35).

Exophthalmos is generally unaffected by thiouracil administration (66, 69, 139, 187). McGavack *et al.* (142) noted no increase of exophthalmos in 38 patients with Graves disease treated with thiouracil. Decreased lid spasm and increased body weight may give the illusion of a decrease in exophthalmos (187). However untoward reactions varying from slight ocular irritation with conjunctivitis and lacrimation (167) to an increase in exophthalmos (19) have been reported (187). Periorbital edema associated with high cholesterol emia has been reported during thiouracil therapy (147). Thyroid substance has been given to prevent untoward ocular reactions (167, 161, 187). Additional accurate ophthalmometric measurements are required before the relation of thiouracil to exophthalmos can be accurately assessed.

Thyroid enlargement, noted subsequent to the feeding of the *Brassicæ* to animals, led to the discovery of the goitrogenic drugs. However there is as yet little agreement as to how much the

human thyroid enlarges or regresses during thiouracil therapy. Apparently the degree of enlargement is not related either to dosage or duration of the treatment (21, 66). Great enlargement, accompanied by a striking increase in vascularity (140) as well as 20 per cent (62) and from 30 to 40 per cent decreases (53) in the size of the thyroid have been observed. Initial enlargement followed by transient decreases after 2 or 3 weeks of therapy have also been reported (142). Watson made measurements of the necks of 35 patients who received the drug and stated that the increase in the size of the neck varied from 0.25 to 1.0 inch and averaged 0.63 inches. Water restriction does not prevent thyroid enlargement in rats given thiouracil (208). The increase in the size of the gland as well as other evidences of goitrogenicity may be prevented by the administration of thyroid substance (58, 89, 95).

Thyroid enlargement induced by thiouracil becomes of major significance when the pre-existing goiter is substernal, retrovisceral, or retrovascular. Severe pressure symptoms due to an enlarging substernal goiter have been reported (206). The tendency for older nodular goiters to undergo vascular degeneration with repeated hemorrhages, together with the ability of thiouracil to cause an increase in the vascularity of the goiter should also be considered whether the goiter is substernal, retrovascular, or simply cervical.

Patients treated with thiouracil often state that they feel better before there is any obvious clinical improvement (142). Tremor, agitation, and perspiration are usually improved before tachycardia is decreased (69). Tachycardia decreases more slowly than the basal metabolic rate (69) and is usually the last sign of hyperthyroidism to abate (99, 187).

A relatively high per cent of remissions of long duration subsequent to thiouracil therapy has not been observed. The ability of any similar drug to maintain decreased thyroid function after its withdrawal would appear to be limited unless it actually destroyed thyroid cells. There are no satisfactory criteria by which to judge the duration of treatment with thiouracil and to determine which patients are most apt to have remissions (139). Six months of treatment before withdrawal of the drug has been advised (6, 204). However McGavack *et al.* (142) have continued treatment as long as 26 months. Williams (214) states that if the initial basal metabolic rate is relatively low and the thyroid relatively small, remissions are more apt to occur than if the initial basal metabolic rate is high and the gland large. He also writes that remissions are more frequent in those pa-

tients in whom the size of the thyroid gland decreases during therapy. Males are more apt to relapse than females. Treatment for less than 6 weeks is usually followed by a relapse within 2 weeks after withdrawal of the drug, treatment for 6 weeks or more usually results in remissions lasting longer than 2 months (20). Relapses are less frequent if treatment is continued for 2 months or longer and are also most apt to occur within 2 months of the withdrawal of the drug (29, 214). After thiourea therapy, remissions are more prolonged if small amounts of thyroid are more simultaneously (58).

Various periods of remission after thiouracil therapy have been observed. Remissions varying from 3 to 21 months (214) from 2 to 7 months (142) from 2 to 11 months (66) from 2 to 15 months (69) from 3 to 7 months (189) and from 8 to 12 months (217) have been reported. Most observers agree that the number of patients followed for a long period after withdrawal of the drug is as yet too small to permit general conclusions (29). Salter and his associates (192) have attributed remissions to a thiouracil hangover effect upon the thyroid cells. However, there is at present no way of determining how long this effect will continue when the drug is discontinued after any given regimen of dosage.

Beierwaltes and Sturgis have re-emphasized the cyclic nature of Graves' disease and have cited Plummer's earlier work which points out that the disease may fluctuate with remissions and exacerbations for from 2 to 4 years before a true remission occurs. It would seem that similar periods should elapse before it could be maintained that a relatively permanent remission was induced by thiouracil.

The cyclic variation of hyperthyroidism makes the evaluation of remissions difficult (191). The many relapses that occur provide good evidence that the effect of the drug may be quite transient once it is withdrawn. There is also evidence that thyroid function may return to and even exceed the normal when administration of the drug is stopped (119, 139).

Diabetes mellitus complicated by hyperthyroidism is benefited by the reduction in metabolic iodine induced by thiouracil as it is by the usual iodine therapy. Revengo (184) noted that the diabetes mellitus was less severe in 7 of 19 collected cases. A decrease in the insulin requirement of such patients was noted by Fishberg and Vorzimmer (66).

The use of thiouracil as an adjunct to the existing means of preoperative preparation of hyperthyroid patients has been advocated by many (21

22, 27, 56, 101, 117, 128, 140, 151, 152, 188, 191, 195, 200, 204, 217). It appears probable that the drug or its allies will find their proper place in the preparation of those patients for surgery who would be very poor risks indeed if prepared by other ordinary methods alone. Here thiouracil should be used as a supplement to the other methods (195) and not as a single therapeutic agent (27).

Many surgeons have noticed that the thiouracil induced hypervascularity often causes a persistent oozing that is difficult to control during surgery. Because of this Bartels (21, 22) advocated the administration of iodine before surgery to cause involution of the hyperplastic gland. This method of preoperative preparation has been most widely adopted and is briefly as follows: — 0.6 grams of thiouracil are given daily until the basal metabolic rate approaches plus 20 per cent and then iodine is administered simultaneously. However, thiouracil is withdrawn about 1 week before surgery and iodine is then given alone. Operation is not advised until the basal metabolic rate is normal and the improvement in symptoms has been maximal (21, 22, 56, 116, 117). Ten milligrams of iodine per day have been found adequate to induce involution in such patients (140). The course during and after surgery has been reported to be more smooth than when thiouracil was used alone (117, 217). Lahey and associates (117) write that this preoperative regimen has all but eliminated the stage of thyroidectomies, and has greatly reduced the mortality among bad risk patients. Montague and Wilson (214) have written that thiouracil will probably find its greatest use in the preoperative preparation of thyrotoxic patients, unless the induced remissions can be maintained for several years after withdrawal of the drug.

King and Rosellini reported that 8 of 10 patients with acute thyroiditis all of whom received thiouracil within 3 weeks of the onset of the disease were given 0.6 gram of the drug daily in 3 divided doses and a subsequent decrease in the body temperature and tenderness of the gland were noted. Two patients that had previously received iodine did not respond. At present there is no understanding as to why the thiouracil therapy was beneficial. The hyperplasia ordinarily induced by thiouracil and its tendency to result in hyperthyroidism are effects that must be carefully evaluated when the drug is given to treat a disease that also tends toward the development of thyroid hypofunction. Additional studies are required before the rationale of thiouracil therapy for such patients can be established.

OTHER GOITROGENS

Thiourea was one of the first goitrogens to be studied extensively (41 55, 58 78, 80 81 86 120 121 187). Clinically, the drug is given in doses of from 1 to 3 grams daily. Its use was discarded because of a relatively high incidence of toxic reactions. Danowski and his associates have recently reinvestigated its clinical use and have reported that much smaller doses than were given previously are effective. The serum precipitable iodine was also decreased by such a regimen. These authors have also advised the simultaneous use of small amounts of iodine and desiccated thyroid.

Astwood and his associates have studied the antithyroid activity of thiobarbital (5 7). Thirty patients were treated and a relatively high incidence of drug fever was observed. Death from agranulocytosis occurred in 1 patient. The drug was given in doses of from 0.2 to 0.3 gram daily. However it is excreted slowly a factor which may account for the increased incidence of toxicity. Bartels (23) has reported toxic reactions in 18 per cent of a series of 28 patients treated with thiobarbital.

Leys treated 19 cases of hyperthyroidism with methyl thiouracil by giving 0.8 gram daily until the basal metabolic rate approached normal limits. Then maintenance doses varying from 50 to 300 milligrams daily were administered. A period of from 10 days to 6 weeks elapsed before the antithyroid action of the drug became evident. Euphoria, eosinophilia, and leucopenia frequently occurred. Drug fever following methyl thiouracil has been reported (206 224).

Williams (213) observed the effects of tetramethylthiourea. In rats goitrogenic activity develops within 14 days, when their drinking water contains 0.04 per cent of the substance. The drug is excreted slowly and relatively high blood concentrations are obtainable. Thirty patients with hyperthyroidism were also treated. Decreases in the basal metabolic rate and blood protein bound iodine were observed, as was also the development of leucopenia and urticaria. Diethylthiourea was administered to 4 patients and the toxic effects were noted in each.

Paraxanthine has been reported to have antithyroid properties (187). However Williams (213) found that it has no effect upon the metamorphosis of *Rana catesbeiana* tadpoles. Likewise, it fails to prevent the increase in oxygen uptake of liver slices such as occurs when these are treated with thyroglobulin. A patient with Graves disease received huge doses of paraxanthine for 11 days and was not benefited. These findings have been confirmed by Barker (15) who gave from 30 to 10,000

micrograms per kilo per day to rats and noted no depressant effect upon the basal metabolism.

Para-aminobenzoic acid decreased the oxygen consumption of rats from 25 to 35 per cent after their drinking water contained 3 per cent for 3 weeks. No toxic symptoms were noted (86).

Higgins (95 96 97) has studied the goitrogenic activity of promizole in the rat and has noted depression of the basal metabolic rate and hyperplasia of the thyroid. This substance is approximately 18 per cent as active as thiouracil (146).

The effects upon rats of 6-methylthiouracil, 5,6-dimethylthiouracil and 2-thio, 4,5-dimethyl-6-methylethylpyrimidine have been studied by McGavack and Vogel (144). These 3 substances are extremely toxic and have a great tendency to cause renal and liver damage. McGinty and Bywater have studied many thiourea derivatives (145) imidazoles (40) and sulfones (146). Pyridine-2-thiol, thiuracil-2-thiol and benzimidazole-2-thiol have goitrogenic properties. Sulfides corresponding to sulfones are more active than the sulfones. Thiourea derivatives have also been extensively studied by Christenson (47). No goitrogenic properties are exhibited by 1,7-dimethylguanidine (15).

Ethyl and also propyl thiouracil have been used both experimentally (8) and clinically (11) by Astwood and his associates. In man, propyl thiouracil is approximately 5 times as effective as thiouracil, and also more active than ethyl thiouracil. The initial dose of propyl thiouracil given to patients was 75 milligrams per day and this was followed by maintenance doses of from 25 to 50 milligrams daily. Propyl thiouracil is now under extensive trial in this and other clinics. Of all the goitrogens thus far studied, it appears the most promising. In 29 patients treated with 6-N-propyl thiouracil, no toxic effects were noted (11).

DISCUSSION AND SUMMARY

Following Astwood's initial announcement of the use of thiouracil in the treatment of hyperthyroidism the thiouracil-like drugs have been widely studied. After 3 years of extensive clinical investigation, certain facts pertaining to their use are generally recognized. The drugs are rapidly absorbed from the gastrointestinal tract, and repeated small doses maintain satisfactory blood concentrations. They enter most of the body fluids and tissues, particularly the thyroid, the blood, the bone marrow and the leucocytes. Transfer across the placenta also occurs and their goitrogenic action has been demonstrated in the fetal thyroid. Drugs of this type appear to be metabolized in the liver and excreted in the urine.

The thiouracil like drugs block the formation of thyroid hormone yet the exact mechanism by which this is accomplished remains obscure. The diminution of thyroid hormone formation with the ensuing drop in the blood concentration stimulates the anterior pituitary lobe to produce more T.S.H. which in turn induces further hyperplasia of the thyroid cells. Moreover the thyroid gland of the organism treated with the thiouracil like drugs is unable to respond to the usual pituitary stimulation. A drop in the basal metabolism consequently ensues. Approximately 1 day of medication is required for each percental elevation of the basal metabolic rate of the hyperthyroid patient. Depression of thyroid function to mixedematous levels may occur. The blood cholesterol, creatinine, and proteins return to normal levels as the metabolism decreases toward normal limits. These goitrogenic drugs further deplete the hyperthyroid organism of iodine which is excreted largely in the urine.

The effects of the thiouracil derivatives on exophthalmos are controversial but an increase in exophthalmos can and does occur during therapy as exemplified by one of our patients. Caution is advised when patients with severe exophthalmos are considered for such therapy. Enlargement of the thyroid and an increase in vascularity occur during therapy with the thiouracil derivatives. This becomes of significance in nodular goiters which may also present hemorrhage or malignancy.

Iodine medication following thiouracil treatment has been successfully used to decrease the hyper vascularity of the glands of patients prepared for surgery with the goitrogens. It has been reported that the operative and postoperative courses of patients prepared with thiouracil are much more quiet than those of patients prepared in the usual way. It has also been reported that the need for a stage thyroidectomy has been greatly decreased by the use of thiouracil preoperatively.

CONCLUSIONS

After an extensive survey of the experimental as well as of the clinical literature including a study of the findings of the patients in our clinic, the following conclusions pertaining to the use of the thiouracil like drugs seem reasonably warranted.

1 The drugs are capable of causing severe toxic symptoms and should not be used unless accurate observations can be made frequently preferably under hospital conditions.

2 The incidence of leucocytic depression is higher than is generally recognized since the criteria used have varied. In the majority of cases careful bone marrow studies have not been made.

The depression of the circulating leucocytes has thus far been interpreted to be due to depression of the bone marrow elements responsible for their production rather than to any effect (as yet undemonstrated) upon the mature leucocytes per se. The development of agranulocytosis is detectable in the bone marrow hours before it is shown by a drop in the circulating leucocytes and similarly the decrease in circulating leucocytes will occur before clinical symptoms develop.

3 Toxic reactions also occur during the treatment of hyperthyroid patients with propyl thiouracil.

4 The presence of nodular goiter should make one hesitant regarding the employment of thiouracil like drugs.

5 The drugs appear to be contraindicated by the following

a Hypersensitivity

- (1) Previous history of multiple allergies to foods, drugs (27, 166) and to foreign proteins
- (2) Previous history of sensitivity to the sulfonamide drugs (27). Simultaneous sulfonamide therapy appears inadvisable
- (3) Previous history of toxic reaction to one of the thiouracil-like drugs

b Bone marrow conditions

- (1) Pre-existing low initial white counts. This would be a contra indication since the patients would appear to possess less reserve if the drug were to depress the granulocytes.
- (2) Pre-existing blood dyscrasias due to bone marrow hypoplasia
- (3) The presence of an infection demands that the leucocyte response be optimal, and few will risk the unpredictable development of agranulocytosis in such cases (27, 32, 34)

c Exophthalmos, if severe, appears to contraindicate the use of the drugs (27, 34)

d Adolescence long continued treatment does not appear advisable at this time

e Toxic nodular goiter long continued treatment is inadvisable if this condition exists. The threat of malignancy developing in such goiters is well recognized. The functioning fetal adenoma falls into the same category (50, 128, 174)

- f. Pre-existing liver disease
- g. Pre-existing adrenal disease. The work of Baumann and Marine (15-16) suggests that thiouracil might cause additional tissue damage.
- h. Pre-existing renal disease, particularly if the renal sufficiency is questioned (166)
- i. Pregnancy. Carefully controlled studies on the experimental animal and in man are not yet available to judge the effects of such long continued therapy accurately on either the mother or the fetus. Widespread use of the drug during the period of gestation should be avoided until further studies are available unless the emergency is dire (17-34)
- j. Large cervical goiter (17) retrosternal goiter (206) retrosternal and retrovascular goiter and retrovisceral goiter as pressure symptoms may result in these conditions.

6. Indications for the use of the drugs appear to be found within that group of patients in whom the risk of thiouracil therapy is less than the risk of the disease when other methods of control are used. *i.e.* patients presenting

- a. Refractoriness to iodine (34)
- b. Hypersensitivity to iodine (185)
- c. Recurrent hyperthyroidism after previous thyroidectomy (34 151 187 195)
- d. Recurrent hyperthyroidism with hypertension.
- e. Ordinarily bad risks (21 23 56 116 117) (for preoperative preparation)
 - (1) Thyrocardias (115)
 - (2) Thyrotoxicosis (187)
- f. Hyperthyroidism, and patients who for one reason or another cannot have surgery

The use of thiouracil alone in the long continued management of hyperthyroidism is now severely questioned. Poate writes that "Early reports have given too optimistic an impression as to the value of the thio drugs. The history of thiouracil is already unpleasantly overloaded with claims for success which have had to be modified subsequently on account of toxic manifestations. McCullagh and his associates (140) state that the "risk of the drug (thiouracil) superimposed on the risk of the disease exceeds the mortality rate with treatment with iodine and competent surgery." Surgery (22) appears to remain the treatment of choice in the management of the majority of patients with hyperthyroidism.

Our own experience further emphasizes the advantages of the well established preoperative management of patients with hyperthyroidism. This consists of sufficient rest, adequate sedation, a high caloric, high vitamin diet, calcium, phosphorus, and vitamin D and iodination. This customary regimen reduces the period of preoperative therapy and hospitalization to a minimum. Moreover it eliminates the time expense, and technical assistance necessary for repeated leucocyte counts. The hypermetabolism resultant to the hyperthyroidism is sufficiently controlled in the great majority of patients without superimposing the risk of the thio drugs upon the risk of the disease, in order to permit adequate surgery. Since 1943, when thiouracil was introduced, 335 patients have been prepared for surgery in our clinic in the manner briefly outlined with a subsequent operative mortality of 0.29 per cent.

Remissions subsequent to adequate thyroidectomy are more certain and longer lasting than are those yet secured by treatment with the thioacil like drugs. It is our opinion that the now well established preoperative management of patients with hyperthyroidism followed by competent surgery will remain the treatment of choice until an antithyroid drug which will have a risk less than that of the disease itself is synthesized. Surgery thus remains the treatment of choice in the management of the great majority of patients with hyperthyroidism.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Cavernous Sinus Thrombosis. Samuel L. Fox and G. Brooks West, Jr. *J Am. M. Ass.* 1947 134 1452.

The term 'cavernous sinus thrombosis' is used to include phlebitis, thrombophlebitis and phlebotrombosis, as well as true aseptic thrombosis. By far the majority of reported cases are of septic origin and would therefore be classified as phlebitic or thrombophlebitic. Aseptic thrombosis and phlebotrombosis are usually secondary to trauma, a falling circulation, or to other noninfectious inflammation of the cavernous sinuses. Although thrombosis of the cavernous sinus is usually unilateral in its clinical manifestations, there is almost always bilateral involvement histopathologically because of the anatomic communications between the two cavernous sinuses by way of the anterior and posterior basilar sinuses, situated on the floor of the sella turcica under the pituitary body.

There are two primary types of thrombosis of the cavernous sinuses: septic thrombosis and aseptic thrombosis. The septic type of thrombosis is by far the commonest is of infectious origin and is secondary to a focus elsewhere. The onset is usually manifested by a severe chill, a high temperature ranging from 102 to 105 degrees F, extreme toxicity and perhaps nausea and vomiting. There is headache, but the patient is mentally alert until meningitis involvement occurs. The first localizing sign is definite edema of the bulbar conjunctiva and chemosis of the eyelids with rapidly progressive exophthalmos of the eye on the affected side, usually becoming bilateral unless the disease is arrested or the patient dies. There is also limitation of movement of the eye (abducens or sixth nerve paralysis) with concomitant alterations in sizes of the two pupils. Meningitis usually occurs rather early after which the sensorium is decidedly affected.

The two commonest conditions which must be differentiated from thrombosis of the cavernous sinuses are orbital cellulitis and lateral sinus thrombosis.

Prior to the introduction of the sulfonamide drugs as therapeutic agents, the treatment of thrombosis of the cavernous sinus was most unsatisfactory and the prognosis was extremely grave whether medical management or surgical intervention was employed.

The prognosis is still grave in spite of advances in the use of chemotherapy, anticoagulants, and antibiotic agents. The treatment of thrombosis of the cavernous sinus is purely medical, and surgical intervention is only indicated at the site of origin of the infection to eradicate the focus. The combined

use of sulfonamide compounds, antibiotics (penicillin, streptomycin and others) and anticoagulants in large doses is strongly advised. If the case is unresponsive to one of the sulfonamide drugs another should be substituted and the same is probably true of the antibiotic agents. The early employment of heparin and dicumarol administered simultaneously also is advocated.

Three cases of cavernous sinus thrombosis are reported (a with unilateral involvement and two with bilateral involvement) with two recoveries. In the first case the condition was unilateral and was thought to have followed adenotomyllectomy. In the second case the condition followed dental extraction with probable secondary sinusitis, and was complicated by meningitis. In the third case it was believed to have occurred following a gumma of the nasal septum with secondary infection in a person with uncontrolled diabetes.

STEPHEN A. ZIEGLER, M.D.

EYE

Specific Treatment of Ocular Burns Due to Lewisite (3-Chlorovinyl-dichloroarsine). Irving H. Leopold and Francis Heed Adler. *Arch. Ophth., Chic.* 1947 38 174.

The authors present information on the specific treatment of ocular burns resulting from lewisite (3-chlorovinyl-dichloroarsine). An effective antisereneal agent, BAL (a 3-dimercaptopropanol) was discovered and developed during the war years which also proved effective against various types of arsenical poisonings in civilian practice.

The value of BAL for the treatment of burns of the eye is summarized as follows:

BAL is superior to hydrogen peroxide and potassium permanganate, which were previously used as therapeutic agents for this condition.

The longer the interval before the application of BAL to an eye burned by lewisite the lower the effectiveness of the treatment. The effectiveness decreases rapidly after from 10 to 12 minutes, but some effect is still present even after 30 minutes. The use of BAL an hour after contamination has no beneficial effect.

Better therapeutic results are obtained by reapplying the drug after the initial application.

Although unstable, watery solutions yielded the best therapeutic results. More stable solutions can be made with ethylene glycol or propylene glycol. These solutions retain full therapeutic efficiency for considerable periods of time under temperatures and exposures to air most likely to be encountered in practice.

Although preservatives do not reduce the therapeutic efficiency of BAL there is no necessity for their employment.

BAL also has been found to be therapeutically effective in ointment bases.

Several drops of 3 and 5 per cent solutions of BAL are just as effective as those of a 10 per cent solution.

BAL has a specific effect not only on ocular lesions resulting from lewisite but also on those from methyl dichloroarsene, ethyldichloroarsenine and phenyldichloroarsine and when used immediately after contamination of the eyes it has a beneficial effect on lesions due to mustard gas.

JOSHUA ZUCKERMAN M.D.

Penetration of Locally Applied BAL into the Anterior Chamber of the Rabbit Eye. Irving H. Leopold and Willard H. Steele. *Arch Ophth.*, Chic. 1947 38 192

The authors discuss the penetrability of BAL into the anterior chamber of the rabbit's eye. They conclude that after local application solutions of BAL in water and in ethylene glycol penetrate through the cornea into the anterior chamber. Penetration from a water vehicle is more rapid than that from an ethylene glycol vehicle. However aqueous solutions of BAL are unstable.

BAL penetrates more readily from a water containing base (K Y Jelly) than from a nonaqueous base (Friedenwald Fuqua ointment).

Greater penetration into the aqueous humor occurs from application of a 5 per cent solution of BAL in water than from application of a 5 per cent solution in ethylene glycol.

JOSHUA ZUCKERMAN M.D.

Gonorrheal Iritis: Experimental Production in the Rabbit. Maurice J. Drell, C. Phillip Miller and Marjorie Bohnhoff. *Arch Ophth.*, Chic. 1947 38: 221

Experimental iritis was produced in the eyes of rabbits, preferably albinos, by the injection of 0.2 c.c. of a saline suspension of two strains of gonococci into the anterior chamber with withdrawal of a like amount of aqueous. That it was a true infection was manifested by the multiplication of organisms and their recovery on culture. Inoculation with various numbers of organisms indicated 200 organisms to be the minimal infecting dose. The appearance of the experimental infection was similar to that frequently seen in such cases in the human eye. There was a gelatinous exudate, intense engorgement of the iris, and hypopyon and hyphemia. The infection remained localized in the anterior part of the eye.

The percentage of eyes yielding cultures containing the gonococcus fell progressively during the first week after inoculation. Injury to the lens at the time of the inoculation had a tendency to seemed to make the infection chronic.

In vivo testing of gonococcal agents was carried out. Details of this work are not related in the present paper, however, it is mentioned that although huge doses of penicillin systematically administered

were necessary to control the infection, as little as 2.5 units of penicillin injected directly into the anterior chamber were efficacious.

It is noted that an exact diagnosis of gonorrheal iritis can rarely be made in man. Paracentesis of the anterior chamber is not ordinarily feasible. Further more it was found that aspiration of aqueous frequently yielded no culture whereas postmortem culture of the tissues sometimes revealed a heavy growth of the organisms. The present knowledge of the immunological reactions in gonorrhea is not extremely helpful in establishing it as the etiologic factor in cases of acute iritis and the diagnosis of gonorrheal iritis must usually be presumptive.

WILLIAM A. MANN M.D.

Central Proliferant (Discol) Cataract and Its Hereditary Transmission. Andrew Rados. *Arch Ophth.*, Chic. 1947 38 57

The author analyzes a hereditary form of cataract variously known as Coppock's cataract (from the name of the family in whom it was first extensively reported), discol cataract (Doyle) or central proliferant cataract (Vogt) on the basis of a study of the family trees of patients whose cases have been reported. It is believed that the mode of inheritance is dominant. Evidence is presented to refute the idea of the recessive nature of the inheritance.

WILLIAM A. MANN M.D.

Substitution of Spinal Fluid for Vitreous. Milo H. Fritz. *Am J Ophth.*, 1947 30 970.

The author presents an historical account in which he describes the previous attempts to clear vitreous opacities by the substitution of normal saline and vitreous for the clouded vitreous. Following the suggestion of Hegner, who in 1929 used cerebrospinal fluid for this purpose, the author reports 4 cases in which cerebrospinal fluid was substituted for vitreous.

In only one case was the effort highly successful. A 13 year-old boy whose vision was reduced to light perception as a result of a traumatic hemorrhage showed a visual acuity of 20/20-1 in a period of 1 year after the procedure. Since the surgery was not performed until 12 months after the injury, it is unlikely that spontaneous improvement would have occurred. The other 3 patients, all of whom were in the late fifties, tolerated the procedure but did not obtain a satisfactory improvement in vision. This may have been due in one case to a previous retinal detachment and in the other cases to retinal damage from retinitis proliferans following repeated spontaneous hemorrhages.

The method followed was to perform a spinal tap on the patient in bed, transferring the sterile cerebrospinal fluid (4 c.c.) to the operating room. A quadrant of sclera was then exposed by making a conjunctival flap and a purse-string suture was placed at the puncture site about 12 mm. from the limbus. An 18 gauge needle is plunged into the vitreous and as much cloudy vitreous is extracted as can be

readily obtained, this usually being 1 to 1½ c.c. The globe collapses but assumes its normal condition when a similar amount of cerebrospinal fluid is injected. Examination with the ophthalmoscope in the successful case showed an immediate clear channel from the posterior lens capsule to the posterior pole, which enlarged subsequently.

This field in which there is at present much interest, may in the future offer some hope in other wise desperate cases. WILLIAM A. MAJOR, M.D.

EAR

A Study of the Eustachian Tubes and Their Orifices and Lumens in Patients with Large Operative Defects Giving Direct Visualization. Further Studies of the Muscles of Phonation and Deglutition. W. Likaty Simpson and Jones E. Witcher. *Ann. Otol. Rhinol.* 947 56 357

Studies were made by direct visualization of the palate, nasopharynx, and regions of the eustachian tubes in 5 patients with large operative defects. The movements of the soft palate, uvula, eustachian tube and lateral walls of the pharynx in pronouncing the vowels and consonants are the same except for degree. The soft palate and uvula are drawn upward. The lateral walls of the pharynx are drawn upward backward, and toward the midline. The eustachian tube mouth is drawn backward and downward, but there is no tendency for the tubes to close. Yawning produces a similar prolonged movement of these parts. In swallowing there is first a minor movement of elevation of the soft palate and medial displacement of the pharyngeal wall, then a major movement consisting of an upward movement of the posterior one-third of the soft palate and uvula, and depression of the remainder of the palate, followed by an upward movement of the entire soft palate and lateral pharyngeal wall. There is hermetic closure of the nasopharynx from the hypopharynx during deglutition. The normal eustachian tube is open at all times and is not closed or occluded by voluntary movements. JOHN R. LINDRAY, M.D.

Chronic Purulent Otitis Media. At St. Cuthbert. *Arch. Otolaryng.* 947 45 37

The first point which the author makes is the wide spread incidence of chronic running ear. There are about 2,800,000 cases in the United States, and the author believes that the responsibility for cure in these cases rests solely with the otologists.

In the great majority of cases, chronic purulent otitis media is believed to be dependent upon chronic purulent sinusitis on the same side as the purulent media, and usually radical surgical drainage of the chronic purulent sinusitis will clear up the chronic purulent otitis media in a dramatic way and in a short time.

A detailed report is given of 5 cases, all with associated purulent sinus disease, in which operation was performed on the sinuses with resultant clearing of the chronic otitis.

In conclusion, the author states that (1) in the great majority of the cases the chronic purulent otitis media can be cleared up the perforation of the drum can be closed the function of hearing, and the health of the patient can be restored by surgical drainage of the purulent sinusitis (2) in those cases in which the mastoid process has become involved the drainage of the purulent sinusitis will greatly facilitate the measures taken to clear up the involvement of the mastoid process, (3) as long as the activating purulent sinusitis is left undrained local treatment will prove unavailing and time-consuming.

The manner in which chronic purulent otitis will clear up following surgical drainage in a suitable case is startling and dramatic.

JOHN F. DUFFY, M.D.

Fenestration of the Labyrinth. O. Popper. *J. Laryngol.* 946, 61 441

The author reports in some detail the transstympanic approach for fenestration of the labyrinth. He states that his greatest problem in carrying out this approach was not the instrumentation, but the question of illumination, stereoscopy and magnification.

The author states that the hazards in this work are very formidable but under control as long as the surgeon can see. Therefore he describes and discusses in some detail the headgear which he has designed to help supply the proper illumination and magnification of the operative field. Briefly it is a headgear with a strong light and lenses which both magnify and light the operative field, as well as giving stereoscopy. A diagram of the headgear is presented.

The author discusses the anesthetic that he uses in carrying out his operation and he does not believe that the type of anesthesia is as important as the anesthetist. He is not greatly in favor of local anesthetics, but prefers general anesthetics—any of the various types, as long as they are given by a competent anesthetist.

Before the beginning of the operation the patient's head is placed in proper position and the skin is prepared in the usual manner. His incision is marked out in a brilliant green—a line running vertically down for about an inch and a quarter immediately in front of the tragus from the incisura tragi to a point somewhat in front of the lobule. He then infiltrates the temporomandibular cleft with a solution of saline containing 6 to 8 minims of adrenalin (1 in 10,000) to the ounce. He uses a fine needle and the point is directed backward, so as to hug the lamina tragi during the whole injection. The incision is made along the marking, now somewhat distorted by the infection. From now onward the operation may be conveniently described as falling into eight stages, as follows:

1. Exposure of the tragal cartilage and the cartilage of the external auditory meatus. The anterior surface of the tragal cartilage is freed and, once this is achieved, it provides a point for insertion of the

closed blades of a medium sized Killian speculum. The blades are gently opened and the whole tragal cartilage is cleared in very short time. The whole of the latter is exposed down to its attachment to the edge of the tympanic plate. An incision along its edge is made and the periosteum carefully reflected. Then the closed Killian blades are placed between the periosteum and the denuded tympanic plate and gently separated. The tympanic plate should be exposed for just over a quarter of an inch.

2 Separation of the cartilage from the edge of the tympanic plate. The author finds that this is very easily done with the use of the Killian blades. Small slivers of broadish cartilage may remain on the edge and they are removed in Stage 3.

3 Removal of portion of the tympanic plate. A long-bladed retractor is used and the posterior blade engages the free edge of the cartilaginous meatus and flattens the latter out against the bony posterior wall. The anterior blade pushes forward the temporomandibular joint plus anterior tissues that are present. When this is done, the drum is clearly seen with its vital landmarks. The edge of the tympanic plate is nibbled down with a rongeur until the entire drum is exposed to view. The author uses a Renter's automatic mallet for this procedure.

4 Fashioning of the tympanomeatal flap and exposure of attic wall and middle-ear contents. An incision about half an inch from the drum down to bone is made sweeping around the remaining portion of the bony meatus. The skin is gently reflected from the meatus and by working all the way around the skin is folded over the drum, its peripheral surface facing the operator. The meatal skin and drum become continuous at the tympanic ring. The posterior segment of the latter is detached from the sulcus tympanicus so that the meatal skin plus the posterior half of the drum may be folded over the handle of the malleus. After this the superlative landmarks in the middle ear are revealed. The meatal skin plus the attached drum are gently tucked into the recess between the remaining portion of the tympanic plate and the anterior part of the drum. The greatest care must now be taken not to tear the tympanomeatal flap with the use of the burrs. The author believes that only diamond burrs should be used as they require less pressure and are far less damaging to soft tissues should the latter be accidentally touched.

5 Removal of attic wall and exposure of incus. The operator uses a cylindrical diamond burr of 1/4 mm. diameter. The object is to drill a hole right through the attic wall to reveal the continuation of the incus in the attic space. Through the drilled hole the incus can be seen and the edges of the hole are then enlarged until the attic wall has been taken down in all directions. The body of the incus, its short process attached in the antral region and its articulation with the head of the malleus anteriorly are now exposed. This is practically all the bone removal that has to be done and the author believes that this minimal destruction of bone is responsible

for his not having any cases of otorrhea postoperatively.

6 Removal of the incus and exposure of the dome of the vestibule and facial canal. The main attachments of the incus are severed and the incudomalleolar articulation is now broken and the incus very carefully removed care being taken not to injure the chorda tympani. When this is done the dome of the vestibule, the facial canal, and other important landmarks can be seen.

The author also mentions an alternative technique to expose the dome of the vestibule but he does so with hesitation and the discussion is not in detail. He hesitates to mention it because the surgeon is deprived of most of his valuable landmarks with his alternate technique. This technique involves stages 4, 5 and 6.

7 Enchondralization of the dome of the vestibule. The author uses a flat-ended or spherical headed diamond burr for this procedure and the entire dome is ground down flat to a level below the facial canal. Bone dust and debris are removed by suction irrigation every few seconds, using a solution of 100,000 units of penicillin in 20 c.c. of saline. The facial canal and all other structures are under direct vision of the operator and they should not be injured if sufficient care is taken. The author does not use the mobile cartilaginous stopple of Lempert as he believes that it is the size of the fistula more than anything else that keeps the fistula open.

8 Replacement of the tympanomeatal flap to cover the fistula. The field is carefully cleansed, and when this is done it is found that the drum falls back into its accustomed place without tension or torsion. The meatal portion of the tympanic flap is placed over the dome of the vestibule its peripheral surface closely adapted to the fenestration. Narrow ribbon gauze impregnated with vaseline and sulfanilamide is gently packed on top of it and into the meatal passage. The other end of the strip is pulled through the intact meatus from below.

The postoperative care is mentioned and the author states that his results have been good and that he has had very little vertigo and spontaneous nystagmus afterwards and what occurs usually disappears after the third day. His patients usually begin to hear much better immediately after operation even with the packing within the ear.

The author discusses a hypothesis to account for hearing improvement after fenestration in otosclerosis. He presents this hypothesis based on the premises that sound transmission occurs through the round window. He considers the tympanic membrane to have three main functions: (1) It is the most perfect receptor for sound (2) It assists by variations of tension to focus for sound (3) It protects the organ of Corti by (a) an immediate tympanostapedial reflex, and (b) by relaxation, curtailing, and dampening sound vibrations.

The author briefly mentions some of the treatments used previously for otosclerosis which were all without value. He believes that the fenestration

operation is the procedure of choice, that it will be found more successful as time goes on and that his manner of the transtympanic approach, in particular will gain acceptance and will be considered the best approach.

The article contains some very excellent colored plates of the different steps in the operation.

WILLIAM A. ARKROW, M.D.

Tumors Involving the Petrous Pyramid of the Temporal Bone. Bruce Proctor and J. R. Lindsay
Arch. Otolaryng. Chic. 1947 45 80.

The petrous portion of the temporal bone may be involved by tumors originating within the temporal bone by tumors arising from adjacent structures, and by tumors metastasizing from distant primary foci.

The origin and the pathologic characteristics of meningioma involving the temporal bone are discussed. A case of meningioma of the temporal bone complicated by acute labyrinthitis superimposed on chronic labyrinthitis produced by the tumor is presented.

A case of sarcoma of the temporal bone is presented and the pathologic characteristics of the tumor are pointed out. Occasionally a tumor of this type is confused with meningioma.

The salient features of diffuse sarcomatosis of the meninges are briefly discussed and illustrated. When sarcomatosis involves the eighth nerve it may be clinically confused with neurofibroma, acoustic neuroma, or meningioma. In the case of diffuse sarcomatosis presented in this report a small focus of otosclerosis was found in each labyrinthine capsule in addition to bilateral involvement of the eighth nerve.

Neoplasms originating in the pons e.g. gliomas, may extend into the internal auditory meatus and interfere with the functions of the seventh and eighth cranial nerves.

A case of bilateral neurofibromatosis of the eighth cranial nerve in which psammoma bodies were observed in both of the internal auditory meatuses is presented. Since these psammoma bodies are usually found associated with meningiomas, their presence in conjunction with neurofibromatosis suggests a possible closer relationship between meningiomas and neurofibromatosis than has previously been suspected.

One case of metastatic tumor of the temporal bone is presented. The bone marrow of the petrous is capable of filtering out tumor cells circulating in the blood stream and becoming a secondary focus for a new growth.

Tumors involving the petrous pyramid of the temporal bone are relatively uncommon, present a wide variety of types and produce such a multififormity of subjective and objective symptoms that it was advisable to report some of the more unusual cases observed at the University of Chicago.

¹Clinics where the temporal bones were obtained for histopathologic examination.

The following types of tumors have been among those reported as primary in the temporal bone: meningioma, sarcoma, squamous cell carcinoma, plasma cell myeloma, hemangioma, epidermoid, dermoid, malignant melanoma, cylinder cell epithelioma and adenocarcinoma. JOHN F. DILLON, M.D.

NOSE AND SINUSES

Malignant Melanoma of the Nasal Mucosa. Charles C. Grace. *Arch. Otolaryng. Chic.* 1947 45 195.

Through the years, the question of the source of malignant melanoma of the nasal mucosa has been a matter of controversy. Wilkinson presenting the earliest report in the British literature in 1912 remarked that it was then generally accepted that these tumors arise in certain cells, stellate or spindle in form, occurring in the skin and the choroid, and less frequently in the mucous membranes of the nose and the mouth.

In the opinion of Ewing, the melanoma is a pigmented tumor arising from a specific mesoblastic cell, the chromatophore or from tactile cells lying in the epidermis or from nerve cells in the dermis.

In the upper portion of the nasal cavity the epithelium of the olfactory mucosa is filled with an abundant supply of granular pigment. It would seem reasonable that this upper nasal mucosa with its wealth of pigment should offer a site as favorable for the development of a melanoma as the richly pigmented surfaces of other parts of the body. However this is not the case for these tumors arise in the mucosa that is without pigment, either in the septum or in the lateral wall, including the turbinate.

In 63 of the cases mentioned in the literature the initial site was given as the nasal cavity in 17 patients, the septum in 21, the inferior turbinate in 14, the middle turbinate in 4, the middle and inferior turbinates in 1 patient, the lateral wall in 4 patients, the floor of the nose in 1 patient, and the external ala in 1. In the case presented by the author the melanoma arose in the inferior turbinate.

Usually the first symptom is unilateral nasal blockage which is soon associated with recurrent epistaxis. Occasionally the hemorrhage is frequent and profuse. Pain is not often a symptom unless the tumor has grown to the extent that there is pressure, or unless there is blockage of a sinus. The discharge of a blackish or ink-black serous fluid is frequently present.

Although pigmentation is usually present in great degree, it is not an invariable criterion in the diagnosis of this lesion. The histologic picture without the assistance of melanin may have to be the guide. The dopa reaction is of value in these instances for it indicates those cells which are true melanoblasts containing the oxidase ferment capable of transforming the colorless chromogenic material in the blood into melanin.

As to treatment, radiotherapy seems to be generally unavailing. Irradiation in addition to surgical intervention was employed in the treatment of 18

patients (43 per cent of the 42 cases in which therapeutic measures were described in any detail) without appreciable benefit.

The slow growth of the primary tumor as compared with the rapid dissemination of the metastatic lesions is an important consideration in treatment. Simple removal of the tumor although apparently complete and followed by irradiation with radium or roentgen rays seems to be of no permanent benefit. Radical removal including a wide margin of normal tissue would appear however to offer a reasonable chance of cure. Often in a nasal operation such removal cannot be performed without resulting deformity and impairment of function but it should nevertheless be undertaken even though the lesion is small.

A case of malignant melanoma of the nasal mucosa occurring in a negro 8½ years of age is reported in detail.

JOHN F. DEXTER, M.D.

PHARYNX

Tracheotomy in Bulbar Poliomyelitis. Robert E. Priest, Lawrence R. Boles, and Neill F. Golts. *Ann Otol Rhinol* 1947 56 230

During 1946 1,830 patients with poliomyelitis were treated in Minneapolis. Approximately 400 were diagnosed as 'bulbar' cases. Tracheotomies were performed in 75 of these. Twenty nine of the tracheotomy patients survived. Of this group 17 lived because of tracheotomy, a probably lived because of tracheotomy and 10 recovered after tracheotomy was done prophylactically.

Indications for tracheotomy included (1) respiratory distress as evidenced by recurrent cyanosis, coarse rales in the chest and laryngeal stridor, (2) unmanageability causing the patient to resist pharyngeal aspiration, (3) stupor of sufficient degree to make the patient oblivious of secretion in his airway, (4) inability to cough effectively, (5) pharyngeal pooling of mucus, (6) vocal cord paralysis and (7) intralaryngeal hyposthenia as demonstrated by laryngoscopy.

Cyanosis can be diagnosed clinically only when anoxia is far advanced and irreversible damage has already occurred to already diseased neural tissue. Tracheotomy should be performed before anoxia has produced damage of the nervous system. Aspiration, bronchitis and pneumonitis, anoxia, and fatigue are minimized by keeping the airway clear. In 15 cases gross amounts of pharyngeal secretion or food or both were aspirated from the trachea at the time of surgery. Immediate relief from anoxia resulted with general improvement in the condition of the patient. No deaths were attributed to tracheotomy. Intermittent pharyngeal aspiration by nasal catheter was found to be superior to continuous suction. All patients have been decannulated but 1 adult who became physiologically dependent on her tube and 1 child who had a residual laryngeal paralysis. Tracheotomy in conjunction with artificial respiration will enable some critically ill poliomyelitis patients to

survive until natural recovery of damaged neural tissue can occur. Seventeen case histories are presented.

JOHN R. LINDSAY, M.D.

NECK

Intratracheal Gopher. Lara, Thorén; *Acta chir scand.*, 1947 95 495

The author reports a case of intratracheal gopher resulting in fatality because of stenotic symptoms. The patient was a woman, age 30 who had a prominent gopher dating from about the time of puberty. For a period of about 5 years she had experienced respiratory difficulties, which were aggravated premenstrually and in connection with two pregnancies. A probable diagnosis of intratracheal gopher was made on the basis of the history, clinical study, laryngoscopy and roentgenograms. Because of the pronounced stenosis preparation was made for operation, but the patient died from suffocation although intubation and other aids were performed. The suffocation may possibly have been due to some great extent to a reactive swelling and hyperemia after treatment with vascular constricting agents used in laryngoscopy. At autopsy and on microscopic examination direct connections were found between the intratracheal gopher and the retrotracheal portion of the outer gopher via the cricotracheal membrane. The increase in size of the intratracheal portion in connection with the pregnancy and an adjacent acute laryngitis were probably decisive in the unfortunate outcome. There were no symptoms of thyrotoxicosis.

There are several theories regarding the genesis of intratracheal gopher. In some cases it most probably occurs on the basis of a total or partial detachment of parts of the thyroid glandular primordium (von Brun, Hultén). In other cases the source might be explained in accordance with the ingrowth theory (Palttauf, Wegelin) which is supported by Wegelin's investigations. The present case can be elucidated both by the ingrowth theory and that of Hultén.

Cases of slight intratracheal gopher may run their course without any appreciable symptoms. When symptoms occur the picture of the disease is dominated by stenosis in the upper air passages which is usually slowly progressive. The first appearance of symptoms often occurs at puberty and exacerbations are prone to occur premenstrually and in connection with pregnancy. At laryngoscopy particular attention should be paid to the region below the vocal cords where the intratracheal gopher takes the form of a rounded even curvature inwards in the subglottic space. The roentgen picture may be typical in some cases and of value in differentiating the lesion from an extratracheal gopher. If stenotic symptoms persist or recur after thyroidectomy for extratracheal gopher in patients in whom these symptoms have been prominent one should suspect intratracheal gopher.

The treatment of the condition is operative. A simultaneous pregnancy constitutes no contraindication.

cation to operation but increases the indication. The intratracheal goiter is extirpated pertracheally or by laryngofissure. Recurrence is seldom encountered. The mortality of operation becomes high when extirpation is performed late and under unfavorable circumstances.

JOHN L. LUNDQVIST, M.D.

Thyrototoxic Crisis. Janet W. McArthur, Rufon W. Rawson, J. H. Means, and Oliver Cope. *J. Am. M. Ass.* 1947 134 868.

This report is on 25 surgical crises and 11 medical crises which occurred among a total of 2,033 cases of thyrotoxicosis during 25 years. Twenty-five of these surgical crises followed 1,383 operations and 11 medical crises followed some precipitating cause. Sixteen of the surgical and 8 of the medical cases terminated fatally. The season of the year exerted but little influence on the frequency of the thyroid crises. The average age of the patients experiencing surgical crises was 46 years. The average age of those experiencing medical crises was 39.4 years. Ten of the 11 medical crises and 17 of the surgical crises occurred in women. Thus a 1 to 3 ratio of males to females experiencing crises occurred. Eight of the medical and 12 of the surgical crises occurred in patients with diffuse goiter. Three of the medical and 13 of the surgical crises occurred in patients with toxic nodular goiter. The relative toxicity of the 2 types of goiter and the mortality rates almost coincided. The majority of crises occurred in patients with thyrotoxicosis of short duration.

A table is presented which summarizes the amount of weight lost between the time of onset and the time of admission to the hospital. Eleven tables are presented in detail which show summary of the data, the age incidence of thyroid crises, the duration of symptoms of thyrotoxicosis, the amount of weight loss, the basal metabolic rate on admission, the therapy prior to hospital admission, the incidence of complicating disease, the pathologic findings in autopsies of 12 patients who died of thyroid crises, the influence of age and complicating diseases on survival, the precipitating factors in the development of thyroid crises, and the factors influencing survival from surgical thyroid crises.

Severe complicating diseases, especially heart disease, were common in thyrotoxic patients in whom a crisis developed and exerted a significant influence on the survival of such patients. Postmortem findings showed that few patients had any demonstrable hepatic lesions but disclosed the frequent occurrence of cardiac and pulmonary pathologic conditions.

The precipitating factors which appeared to be provocative of crises were thyroidectomy (14 cases), pneumonia (7 cases), iodine withdrawal (4 cases), postoperative hemorrhage and secondary anuria (3 cases), wound sepsis (1 case), and digitalis intoxication (1 case). Patients who failed to gain weight and whose symptoms were not improved preoperatively did not survive thyroid crises.

Three case histories are discussed in detail and it is suggested that in every case of thyroid crisis

therapy should be individualized to correct all the abnormalities. It is necessary to continue the administration of antithyroid drugs until the patient is in a suitable condition for surgery.

RICHARD J. BERNETT, JR., M.D.

Carcinoma of the Thyroid. Robert C. Horn, Jr., Robert F. Welty, Frank P. Brooks, Jonathan E. Rhoads, and Eugene P. Pendergram. *Ann. Surg.* 1947 126: 140.

Although most thyroid cancer occurs in nodular goiters, the incidence of malignant tumors in nodular goiters has been regarded by many physicians as too low to be accepted as a valid indication for their routine removal. However as the operative risk has declined, it has become probable that life can be saved by taking a more radical attitude toward nodular goiters. The use of postoperative radiotherapy has been a moot point and it is with a view to clarifying this subject that the authors have reviewed all of the cases observed at the Hospital of the University of Pennsylvania, Philadelphia, for as 11 1/2 year period.

Seventy-one patients with carcinoma of the thyroid and 3 patients with lateral thyroid carcinoma were treated during this period. Sixty-two cancers of the thyroid were encountered among a series of 2,070 surgically treated patients with thyroid lesions, an incidence of 3.0 per cent. Among 2,135 surgically treated nodular goiters the incidence of carcinoma was 5.5 per cent.

Thyroid carcinomas occurring in the younger age groups tend to be the less malignant of the pathologic types of the condition and are less advanced in their growth when they first come under observation. Seventy per cent of the carcinomas in the authors' series occurred in patients between the ages of 40 and 70 years, and 76 per cent of the growths occurred in women.

The majority of thyroid carcinomas are of the papillary or malignant adenoma types, and these may be grouped together as grade I tumors, i.e., tumors of low grade malignancy. Fifty-eight per cent of patients treated for tumors of this type survived for a period of more than 5 years, and 60 per cent of the patients treated longer than 1 year ago are alive and well. Although the prognosis in tumors of other pathological types is poor, the 10 year survivals in the authors' series include 1 patient with a small cell carcinoma and 1 patient with a giant cell sarcoma.

The extent of the disease at the time treatment is instituted is more important prognostically than its pathological type. Eighty-six per cent of the patients whose tumors were discovered only on pathological examination and who were treated more than 5 years ago, are alive and well. Seventy-five per cent of such patients treated more than 10 years ago are alive and well.

Many patients with thyroid cancer develop metastases or recurrences 5 years or more after their initial treatment. This series includes 1 patient who

died with metastasis more than 10 years after thyroidectomy

In view of the relatively small risk of operation it would appear wise to recommend the surgical excision of all nodular goiters unless strong contraindications exist. The extension of carcinoma through the capsule of the gland indicates the institution of postoperative irradiation. It has been especially effective in the papillary carcinomas. The benefits of postoperative irradiation in cases in which the carcinoma has not extended through the capsule are not clear from the present study. So many of these patients do well that a considerably greater experience will be required before postoperative irradiation in this group of cases can be finally evaluated.

ERNEST D. BLOOMENTHAL, M.D.

Aberrant Papilliferous Cervical Tumors (Tumores papilliferos cervicales aberrantes. Parte anatomoclinica) A. Bianchi *Arch. cubanas cancerol.* 1947 6 117

Aberrant thyroid tissue may give rise to cervical tumors which can be found isolated in lymph glands or other associated lymphoid tissue. Because of the slow growth of these tumors and their malignant appearance they are frequently mistaken for a malignant process although a papilliferous structure may be found both in carcinomatous or noncarcinomatous tumors.

To overcome this difficulty of differentiation one must carefully study the histological appearance of the cells that cover the papillae, capsulation of the tumor and, lastly, invasion of the blood vessels. Some papilliferous structures in the lymph glands have their origin from malformed pharyngeal tissue, as in the latter epithelial and lymphoid tissues are side by side in the embryo. A fibrous capsule between the papilliferous process and the lymphoid or thyroid tissue is of diagnostic value as it indicates whether one is dealing with a malformation or a metastatic process.

ARTHUR F. CIPOLLA, M.D.

Nature and Characteristic Features of Laterocervical Branchiogenic Carcinoma (Natura e caratteristiche dei carcinomi branchiogeni laterocervicali) Federico Pizzetti *Tumori Milano* 1947 33 25

Some writers deny the existence of laterocervical branchiogenic carcinoma but the author advances valid arguments in favor of such a clinical entity. He bases his opinion on personal observations and clinical, embryologic, and anatomopathologic data. The generic term 'branchiogenic tumor' branchioma, or cervical embryoma is frequently applied to a variety of tumors.

The following conditions should be taken into consideration in the differential diagnosis: various types of carotid paragangliomas, lymphoepithelioma, rare epitheliomas deriving from an ectopic inclusion of salivary gland in cervical lymph glands, carcinoma of the thyroglossal duct, certain forms of pseudocarcinomatous mixed tumors of the salivary glands and various types of connectivoma.

Two types of tumors originating from the branchial cleft may be distinguished: (1) benign, represented by branchial cysts and encapsulated adenolymphomas and (2) malignant, represented by branchiogenic carcinomas in the strict sense of the word.

Among 100 cases of lateral tumors of the neck observed by the author, he found 11 in which the diagnosis of laterocervical branchiogenic carcinoma could be established. Only 3 patients were younger than 40 years. The tumors were located in the mesenchymal area and showed a relatively rapid growth. They were of hard consistency and showed a tendency to adhere to the skin only in advanced stages. Secondary ulceration of the skin occurred in several instances. Metastases were found in the liver, bones, lungs and regional lymph glands. The pharynx was secondarily invaded in 1 patient.

The autopsy revealed a typical macroscopic aspect of carcinoma with occasional necrotic or pseudocystic areas. The histologic examination established the presence of structures of ectodermic and entodermic origin.

JOSEPH K. NAKAT, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Isolated Oculomotor Palsy Caused by Intracranial Aneurysm. Geoffrey Jefferson *Proc. R. Soc. M. Lond.*, 1947 40 2 9.

In order to study each aspect or type of symptom found in cerebral aneurysms, the author discusses the occurrence of an isolated oculomotor paralysis as the essential feature. Fifty five aneurysms out of a total of 158 had this isolated paralysis. Although it is agreed that the majority of patients had congenital aneurysms it is believed that they probably developed later in life from congenital defects and in a sense, may be compared to inguinal hernias appearing in later life.

The most common site is the distal portion of the internal carotid artery soon after entering the intracranial cavity by piercing the dura mater and hence is supraclinoid in position. The posterior communicating artery may be either above or below the aneurysm. The constant features are that the aneurysm has a pear-shaped configuration and faces posteriorly. The aneurysm occurred on the basilar artery in only 3 of a total of 55 cases.

All portions of the oculomotor nerve are not equally involved. Although ptosis is the most common finding many patients will note diplopia before the ptosis. The patients often stated that the eyelid felt heavy and that this with the pain, caused them to close the eye although after several days to a week they may awaken to find they are unable to open the eye. The pupil is at first classically dilated but usually within 2 to 4 weeks may contract slightly. Recovery starts in several weeks regardless of whether the carotid is ligated or not. This is almost never complete, the least recovery occurring in the superior rectus muscle.

Pain is a very characteristic and distinguishing symptom. It is always in the ophthalmic division of the trigeminal nerve ipsilateral forehead and about the inner canthus of the affected eye. When associated with severe occipital headache and nuchal rigidity it is indicative of subarachnoid hemorrhage. Anesthesia is not usually present but if it is the aneurysm is subclinoid.

Subarachnoid hemorrhage occurred in 30 patients, or 70 per cent of the cases. Although it was fatal in 7 cases, while the patients were in the hospital it is surprising to note that nearly all immediate survivors are still alive.

Arteriosclerotic aneurysms were present in 10 per cent of the patients about a third of whom were hypertensives. An important finding is that hypertension in the older age group is not an absolute contraindication to carotid ligation since 2 patients 57 and 56 years of age had internal carotid and common carotid ligations, respectively and were alive

and apparently without ligation sequelae after 2 years in 1 case and after 6 months in the other. As might be expected many of these patients are poor risks and do not warrant surgery, death usually resulting from angina or myocardial failure.

The differential diagnosis is seldom a particularly difficult problem. So-called ophthalmic migraine can be differentiated by a detailed and careful history revealing the absence of residuals. Carcinoma of the nasopharynx does not give an isolated third nerve palsy. Although the author encountered 3 pituitary adenomas with oculomotor paralysis, an associated visual field defect was found in all patients.

The surgical approach finally selected as the procedure of choice was ligation of the carotid trunk. In some cases the common carotid was ligated first and later the internal carotid however the results were as good in one as in the other. After a fatality from an attempt to clip the neck of an aneurysm intracranially, this procedure was discarded as too hazardous although intracranial carotid clipping, or ligation and trapping of the aneurysm is considered satisfactory. The former was performed in 23 cases. The operations on the 3 patients who died within a day or so were emergency ties, as the patients were semi comatose. One patient died 7 years later from an unknown cause hence 10 patients have survived. In 3 other cases an attempted ligation was abandoned due to hemiplegic signs.

The most important criteria in suggesting surgery is pain since it is felt that pain implies that some activity is occurring in or about the aneurysm.

The most astounding finding is that "few patients who remain pain-free come to any harm whether operated upon or not." JACK L. WOOLSEY M.D.

Neurinomas of the Cerebellopontile Recess. A Clinical Study of 164 Cases Including Operative Mortality and End Results. Antonio Gonzalez Revilla. *Bull. Johns Hopkins Hosp.*, 1947 80 254.

This study of neurinomas of the cerebellopontile recess was based on operations performed by Walter Dandy at The Johns Hopkins Hospital in the period from 1926 to 1945. There was a total of 160 cases, of which 145 were acoustic neurinomas, or those originating predominantly from the eighth nerve. There was an extreme variation in the ages of the various patients, ranging from 13 years of age to 69 years of age. The average age of the patients derived from the onset of symptoms was 39.6 years. The average age on admission to the hospital was 44.2 years hence there was an average duration of symptoms before surgery of 4.56 years.

Although the prominence of the elements varies in the symptomatology the various elements were, nevertheless present in most cases. Auditory and labyrinthine symptoms were present in every case.

They were noted as the initial symptom however in only 68.6 of the cases. Diminution of the auditory acuity was subjectively present in all cases despite the fact that there was no objective evidence of hearing loss in 5 cases. Tinnitus was present in 62.3 per cent of the cases. Cerebellar symptoms such as unsteadiness in walking, staggering, clumsiness were present in 86.2 per cent of the cases. Headaches were not as frequent as noted in earlier reports; however they were present in a little over two-thirds of the cases and were noted as the initial symptom in 12.4 per cent of the cases. The headaches were usually localized to the occipital region although at times they were quite variable extending from the suboccipital to the frontal region. Symptoms referable to the trigeminal nerve were found in 56.5 per cent. Numbness was usually the predominant sign although an occasional case suggestive of a typical tic douloureux was noted. Evidence of involvement of the facial nerve was present in only 15.8 per cent. The sparing of the facial nerve remained a surprising finding as has been noted in the past.

Audiograms were performed in all cases except 1. Some degree of impairment was noted in 95.8 per cent of the cases. This was found to be as follows: there was total deafness in 107 cases and partial in 32. Although 5 cases showed no abnormal changes in the audiogram it should be noted that these cases showed disturbances in vestibular function. The cold caloric test for vestibular function was not performed routinely. Among 87 cases however in which it was used there was a loss of caloric response in 66 cases and a partial disturbance in 11.

From these findings it was concluded that one would expect involvement in some portion of the eighth nerve in all cases of acoustic neuromas. It is disclaimed, however, that all acoustic neuromas arise from the vestibular portion of the nerve rather than the author believes that they may arise from either the vestibular or the auditory branch as has been proved by the work of Hardy and Crow.

The operative mortality rate has diminished with the evolution of newer approaches as advocated by Dandy with the natural improvement in technique which occurs over the passage of years. With the unilateral cerebellar approach and careful intracapsular dissection there was a mortality rate of only 6.5 per cent in patients operated upon in the last 8 years. The author reports the outstanding figure of only 2.4 per cent or 1 fatality in 41 patients who were operated upon in the past 5 years.

An analysis of the operative deaths reveals that neither age nor symptoms have any particular correlation with the cause of death since there was no greater predominance in either young or old patients nor any correlation with the severity of the symptoms. A surprising finding was a very definite increase in mortality rate in males. The average weight of the tumors removed was 27.6 gm. The greatest primary cause of death was direct trauma to the brain stem. Other factors were meningitis, pulmonary complications, and vascular complications.

Although the importance of preserving the facial nerve is well recognized and emphasized this could be done in only 9 cases. Needless to say it was felt that despite the great desire to save the facial nerve the possibility of adherent tumor capsule to the nerve made it necessary to sacrifice it in most cases. X ray evidence of destruction of the porus acusticus was present in only 50 per cent of the cases. Hence, the absence of x ray evidence of bone destruction of the acoustic canal should not hinder one in making the correct diagnosis.

The association of unilateral acoustic neuromas with peripheral neurofibromatosis was found to be very infrequent since only 5 cases with this association were found in a series of 160 cases of cerebello-pontine recess tumors. In studying this specific type of tumor it was noted that the age at the onset was definitely far below the age of patients with solitary neuromas that is the age group revealed an average age of 24.3 years. The average age at the onset of symptoms was only 14.3 years with a quite prolonged duration of symptoms (10 years). The symptomatology was very similar however to that of the type without acoustic neuromas. At the time of operation however it was noted that the neuromas were extremely hard, which made their removal by curettage a very difficult and extremely hazardous procedure. With the possibilities of other neuromas and the possibility of development of meningiomas the final outcome was very bad. In the present series of only 3 cases there was 1 operative death, 1 death 7 years later from recurrence and 1 patient living and well at the end of 6 years.

Bilateral acoustic neuromas were found in 6 cases representing 3.7 per cent. There was a rather definite relationship with von Recklinghausen's disease since 3 cases representing 50 per cent, showed definite evidence of peripheral neurofibromas. A more striking correlation was noted to be a hereditary transmission with familial predisposition. This was noted in half of the cases. The symptomatology was not a great deal different from that of other neurofibromas except that it was more similar to that of the cases of unilateral neuromas associated with von Recklinghausen's disease that is this condition usually occurred in definitely younger individuals the average age at onset being 17.8 years of age. The symptoms however, were usually of some what shorter duration probably because of the bilateral involvement. As would be expected the operative mortality of such tumors is definitely higher because of the difficulty of operating on 2 sides and the greater possibility of edema resulting from operation in a reduced space. Hence the best approach with extirpation of the tumor is a bilateral cerebellar approach.

Neuromas of the fifth nerve are comparatively rare comprising 3 cases of the present series. The symptomatology was very similar to that occurring in acoustic neuromas with the exception that trigeminal symptoms preceded auditory and labyrinthine disturbances by an average of 4½ years. In 3

of the patients the symptomatology was that of tic douloureux. There was no immediate operative mortality. However a careful follow up could not be obtained in any case. An interesting finding was that in 1 case there was a marked return of auditory function following operation.

Neurinomas of the tenth nerve occurred in only 3 cases. There was 1 very definite and predominant symptom found in both cases, and this was hoarseness which was the initial symptom in 1 of the cases. The remainder of the symptoms may at times represent quite a problem. However as a whole they might mimic any cerebellopontile tumor or an acoustic neuroma. There was no operative mortality in this group.

Only 1 case of neurinoma of the eleventh nerve was found, and in this case there was a very definite connection with the generalized neurofibromatosis.

JACK I. WOOD, M.D.

Penicillin in the Prevention of Infection during Operations on the Brain and Spinal Cord.
J. B. Pennybacker, Margaret Taylor and Sir Hugh Cairns. *Lancet* Lond. 1947 3: 59.

A study was made of the local use of calcium penicillin powder mixed with sulfamesathine in the prevention of infection of operative wounds in brain and spinal cord conditions. There were 5,000 units of penicillin per gram in the mixture. The powder was lightly insufflated onto the various layers of the wound including the surface of the brain and spinal cord. At 40 operations an average of 1.4 grams (7,000 units of penicillin) of powder was used. In a study of one series of 24 cases of tantalum cranioplasty and a second series of osteoplastic craniotomies, 10.3 grams of powder were used and it was found that penicillin was usually present in the wound in adequate bacteriostatic concentrations for 18 hours. The first 24 hours are the most important in prevention of the establishment of infection.

No convulsive seizures followed the application of this powder to the brain. In some laminectomy wounds where a large surface of muscle was exposed a slight excess of exudate was noted, and the wounds were drained through a small stab incision.

During the prepenicillin era from May 1938 to November 1944 there were 169 clean major cerebral and spinal operations performed at the authors' hospital. Among these, 51 cases were infected and in 13 cases the infection was fatal. From December 1944 to March, 1947 penicillin sulfamesathine powder was insufflated locally into 670 similar type wounds with the result that there were 6 wound infections with no fatalities from these complications. Thus the incidence of infection was cut from 4.4 per cent in the prepenicillin era to 0.9 per cent with local application of the penicillin-sulfamesathine powder.

The powder gives only slight assistance to the body in overcoming wound infection. It does not prevent virulent infections nor does it replace any of the measures used to combat infection at the operating table.

RICHARD C. SCHWEDER, M.D.

SPINAL CORD AND ITS COVERINGS

Peripheral Extension of Radiopaque Media from the Subarachnoid Space. J. Douglas French and William H. Strain. *Surgery* 1947 3: 380.

In a series of 300 consecutive myelograms, 4 cases were encountered in which pantopaque extended outside the normal confines of the subarachnoid space apparently along the nerve roots. A report of these 4 cases is presented. In one case a definite anatomic abnormality was demonstrated at operation. The second case was one of subarachnoid block just above the point of injection, and extension of the medium along the nerve root was thought to be due to anatomic changes which developed as a result of a chronically obstructed arachnoid space, as well as pressure alterations produced by the injection of additional fluid into a small closed space, and also probable injection directly into a nerve root rather than into the subarachnoid space. In the third case, the probabilities are that the material was injected outside the subarachnoid space. In the fourth patient, injection is thought to have been made presumably into the perineural spaces of the nerve root.

The author has conducted experimental work on rabbits and dogs, with injection of radiopaque media in the peripheral nerves and into the subarachnoid spaces of the spinal canal, under normal and increased pressure conditions. In another group, injections were made into the intracranial subarachnoid space under physiologic pressures.

Under normal pressures, it was found that the opaque materials made rather rapid exit from the intracranial spaces, through the cribriform plate, into the nasal secretions and cervical lymphatic system. Extension of radiopaque material from the lumbar region was never observed under physiologic conditions, but did occur into the perineural spaces when excessive pressures were applied or the animal was killed.

Peripheral injections of nerves indicated that there may be a connective tissue plane organized from the dural perineural sheath which form discrete channels in such a fashion as to subdivide the progressively branching nerve into longitudinal compartments supporting axis cylinder extension.

No evidence could be found to indicate that there is a physical communication normally between the spinal subarachnoid space and the peripheral nerves. Under unusual circumstances, such extension may occur along the nerve sheath from the subarachnoid space.

HOWARD A. BROWN, M.D.

PERIPHERAL NERVES

Injuries of Peripheral Nerves in Two World Wars. W. Rowley Bristol. *Brit. J. Surg.* 1947 34: 333.

The author discusses the influence of Sir Robert Jones on surgery of the peripheral nerves, and gives a brief résumé of his work in this field.

A further discussion ensues with reference to developments in peripheral nerve surgery during World

War I including end to-end suture assessment of results from nerve graft (which was uniformly poor) and the conclusion that neurological recovery always fell short of perfection under the best operative conditions.

The use of splints to overcome and prevent deformity is outlined although it is also stressed that preserving joint mobility is essential. Physiotherapy was apparently used more in World War I than in World War II in the British Army.

The operative technique employed in World War II is outlined and includes wide anatomical exposure, alterations in position of the limb, stripping of branches transposition of nerves, bulk suture of the sheath with stainless steel wire and fine nonabsorbable thread is recommended. Protection of the suture line with nonabsorbable material proved unsatisfactory.

The problem of primary and secondary suture is discussed and ideas for and against these procedures are presented. It would appear to be evident that delayed suture (2 or 3 weeks after injury) may have some advantages in some series a greater percentage of success in delayed sutures is reported in contrast to primary sutures.

The author is inclined to believe that delayed suture is not advisable unless there is good reason to delay as in an open wound with potential infection which otherwise would be an end to-end suture. Neurolysis is not considered a very valuable procedure although the author has not clearly defined what he considers a neurolysis to be.

Composite tables have been set up to assess motor and sensory recovery. These include various degrees of sensory recovery and motor improvement a review of the tables permits a ready evaluation of a case or group of cases. Recovery in various nerves has been considered and the radial nerve again heads the list of recoveries. Recovery in median nerve in injuries follows. In injuries of the upper extremities recovery in the ulnar nerve was poorest. In the lower extremities medial popliteal sutures showed a fairly good degree of recovery while lateral popliteal results were poor.

Nerve grafting both heterogeneous and homogenous was considered a failure.

HOWARD A. BROWN, M.D.

Surgical Experiences with Peripheral Nerve Injuries.
Herbert J. Soddon. *O Bull. Northwest Univ. Med. School* 1947 11: 201.

About 2,500 cases of peripheral nerve wounds in military and civilian personnel were studied in England and Scotland at 5 centers devoted exclusively to treatment of this type of injury. The classification of types of peripheral nerve injury devised by Professor Henry Cohen was used namely neuropraxia, neurotmesis and axonotmesis. In neuropraxia there is no axonal degeneration and no change in the muscles supplied by the affected

nerve. The essential lesion is presumed to be due to fragmentation of the myelin sheath. Recovery is complete and rapid.

Neurotmesis is defined as an injury in which fibers of one kind may grow into tubes leading to end organs of another kind as a result the axon is wasted with subsequent imperfect innervation.

In axonotmesis the fibers may grow into a Schwann tube of the proper kind but leading to a destination different from the one originally served by that particular fiber. As a result there is a permanent impairment of a point discrimination sensibility weakness in individual muscles and imperfect participation in synergic movements.

In regeneration there is a progressive diminution in the rate of growth the process becoming slower as it approaches completion. Nevertheless the rate may be approximately constant over moderately long periods and in man is roughly from 1 to 1.5 millimeters per day. The decrease in rate of regeneration may be due to progressive shrinkage of the Schwann tubes in the peripheral stump after section of a nerve. As a result the growth in diameter and myelination are hindered and both of these are noted that there were noxious changes in the muscle itself and that progressive atrophy had a retarding effect on reinnervation and function. Atrophy of a denervated muscle is reversible up to a certain point. Its greatest effect is that of interstitial fibrous invasion. Schwann tubes where they approach their innervation. The proximal fiber is prevented from reaching its old motor end plate.

In general, primary nerve suture gives less satisfactory results than early secondary repair for the following reasons:

1. The extent of intraneural damage in a severed nerve cannot be adequately evaluated immediately and it is only after a few weeks of growth that fibrosis of the damaged zones becomes apparent.

2. Suture of the epineurium is always carried out rather than suture of the nerve itself. This structure is usually quite thin at the time of injury. After a short interval a certain degree of thickening occurs which permits a firmer suture of the epineurium and one that is more accurate in apposition.

Mobilization of the nerve stumps is essential to avoid tension at the suture line. In order to accomplish this it is necessary to expose larger areas of tissue with the risk of spread of infection.

A review of 1,681 cases during this period showed that 41.5 per cent required surgical repair. A breakdown of these figures is given. In considering nerve grafting it was believed that heterogeneous grafts were a failure, homogenous grafts were moderately good, and autogenous grafts were most successful. The factors involved in nerve grafting are discussed. In a series of 58 cases of autogenous grafts the degree of regeneration was sufficient to justify the procedure in more than 50 per cent of the cases. In general, the results were encouraging when the severity of these wounds is considered and the author no longer

regards autogenous nerve grafting to be merely an experimental procedure

RICHARD C. SCHÖNEMER, M.D.

An Operation for Nerve Pedicle Grafting. F. G. St. Clair Strange. *Brit. J. Surg.* 1947 34 423

The author reports a method of nerve grafting employed in one patient with injuries involving both the median and ulnar nerves in the forearm. No follow-up studies to indicate the result, are reported.

The author recommends the method in an attempt to improve the circulation to the graft, but it would require a situation in which two nerves were involved, and one must be sacrificed in an attempt to improve the second.

In this case, the proximal ends of the two nerves were identified and resected until satisfactory nerve bundles were found. These two nerves were then approximated, both being proximal segments.

At a second stage operation about 6 weeks later the ulnar nerve was freed at a considerably higher level than the point of suture of the two proximal ends and was then divided. The nerve was then swung downward and carried through a tunnel so that it could be approximated to the distal portion of the median nerve below.

The author believes that such a pedicle nerve autograft may have application in certain special situations of the type here described.

HOWARD A. BROWN, M.D.

Regeneration of Severed Nerves. Lewis J. Pollock, James G. Golsmith, Frank Mayfield, Alex J. Arieff and Others. *J. Am. M. Ass.* 1947 34 350.

The authors present evidence that regeneration of a distal segment of an injured nerve occurs in spite of separation of the segments. Proof of regeneration is seen when there is recovery of voluntary motion, recovery of sensation in the isolated supply of a nerve, histologic evidence of fibers in the distal segment, response of muscles to direct electrical stimulation of the nerve and reactions of muscles which show there is no complete denervation when they are stimulated electrically. A chronaxia of less than 15 milliseconds for response to faradic stimulation and a galvanic tetanus ratio of more than 1.0 satisfy the latter requirement. The galvanic tetanus ratio of a completely denervated muscle is 1.0. Since regeneration and degeneration proceed simultaneously there may be instances in which the galvanic tetanus ratio may never be found to be 1.0.

Eighty-four cases were selected for study. The ends of the nerves were separated by gaps up to 9 cm. in length. Only in 1 case did stimulation of the distal segment produce a response when it was studied at the time of the original operation.

At surgery very few instances of a galvanic tetanus ratio of 1.0 were found, some being as high as 2.0. When the cases were studied after suture the ratio was less than at surgery but still above 1.0 in most instances. On later examination the ratio again rose. These changes in the galvanic tetanus ratio indicated that nerves degenerate and spontaneously regenerate. Histologic material was available in some instances and the presence of neurofibrils substantiated the belief that regeneration had occurred.

DANIEL REED, M.D.

SYMPATHETIC NERVES

The Surgical Treatment of Hypertension. The "Neurogenic" Versus Renal Hypertension From the Standpoint of Operability. Gen. de Talarin and Edson Fairbrother Fowler. *Surgery* 1947, 31 773.

The authors present case histories of 18 patients who had bilateral thoracolumbar sympathectomies for hypertension. In addition, they give a table which groups 50 patients into 3 categories: 8 with nonrenal hypertension, 23 with renal hypertension, and 19 unclassified.

To meet the requirements of a nonrenal hypertension, the following conditions must be present: (1) normal renal structure in a hypertension of long standing; (2) history of a previous thyroidectomy for a toxic goiter; (3) the finding of a medullary or cortical tumor of the adrenal gland.

It is generally assumed that nonrenal or neurogenic hypertension is the ideal type for splanchnic nerve section. Some workers have made an effort to differentiate neurogenic from renal hypertension by the response of the patient's blood pressure to high spinal anesthesia. The authors' experience, however, has not supported the view that the nonrenal hypertensives do better after operation than those with definable renal damage. The authors perform renal biopsies at the time of sympathectomy. The types of renal pathology demonstrated were unilateral hypoplastic kidney, renal trauma, post toxemia, pyelonephritis and streptococcus nephritis.

The conclusions reached are that the so-called neurogenic group has not responded well to sympathectomy, whereas the renal group provided renal damage is not too advanced, has responded favorably. Patients who have had pyelonephritis, post toxemic hypertension, streptococcus nephritis and rheumatic renovascular damage are favorable candidates when the original process has subsided and the resulting renal arteriolar sclerosis remains. Probably the neurogenic type of hypertension is not mediated by the sympathetic nervous system.

DANIEL REED, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Nerve Blocking Therapy for Fractured Ribs. D J Richardson and E. M. Papper *J Thorac Surg.*, 1947 16 432.

The application of regional nerve blocking to the therapy of disease or injury has often been made with the primary purpose of controlling the associated pain. Experience with 230 patients has shown that paravertebral injections of analgesic solutions are indicated to eliminate the pain of fractured ribs and are definitely useful to prevent more serious complications and to reduce mortality.

A variety of solutions was used in the treatment. The most common solution was procaine 1 to 2 per cent, which, in about two-thirds of the cases, was followed by the injection of 1 to 2 c.c. of absolute alcohol. Other solutions used were procaine and ammonium chloride intracaine monocaline and several experimental drugs. The results varied but little.

Following the initial injection there was almost immediate relief of pain in 80 per cent of the cases. Less than 25 per cent of the patients required more than one treatment. Among the patients presented 93.5 per cent had multiple rib fractures and more than a third of the entire series had major complications associated with trauma.

The mortality rate in the complicated cases was 12 per cent and the total mortality was 4.1 per cent. These results indicate that pain relief with nerve block is of significant value in preventing pulmonary infections and death of patients with fractured ribs.

SAMUEL KAHN M D

Treatment of Cancer of the Breast with Estrogenic Hormones (I preparato estrogenico il cancro della mammella) V. Pricolo *Tumori Milano* 1947 33 46

The following conclusions are drawn by the author from observations on 18 patients with cancer of the breast who were treated with estrogenic hormones.

The administration of estrogenic hormones has a definite effect on the primary tumor and the metastases although the effect is only of a transient character. The hormones have a beneficial effect on the painful phenomena and the general condition of the patient. The results are especially noticeable in elderly women, particularly during the menopause. The administration of estrogens should not be considered a substitute for surgery, radiosurgery or the administration of radium.

Estrogens are indicated in inoperable cases because the patient's life may be prolonged.

The author recommends the repeated administrations of moderate doses, such as from 100 to 200 mgm. per series of treatments. High doses should be avoided especially in adolescents and women during the period of sexual activity.

The author usually injects from 5 to 10 mgm of estrogen daily or on alternate days until a total dose of 200 mgm. has been reached. In this manner the toxic effects of estrogen such as nausea, vomiting, grave hemorrhages from the breast or the tumor, metrorrhagia, thermic reactions, dermatitis, and edema may be avoided.

JOSEPH E. NARAT M D

The Use of Testosterone Propionate in the Treatment of Advanced Carcinoma of the Breast. The Treatment of Osseous Metastases. Julian B. Herrmann, Frank E. Adair and Helen Q. Woodard. *Surgery* 1947 22 101

The subsequent course in 3 cases of osseous metastases reported previously (*Ann Surg.*, 1946 123 1023) and the results obtained in an additional 11 patients with osseous metastases are presented.

The favorable results obtained in the present series were with smaller amounts of testosterone propionate than previously used. Dosages successfully employed were 100 and 200 mgm. biweekly and 100 mgm. triweekly. Less satisfactory results were obtained with biweekly doses of 50 mgm. Treatment is usually continued until the patient becomes asymptomatic.

Bone lesions appear to remain quiescent for a variable length of time after androgen therapy is terminated. When pain recurs it can be controlled by additional therapy.

Symptomatic improvement was evident within 3 weeks in 8 of the patients. In 6 patients roentgenologic evidence of calcification in metastatic areas appeared and in some this was discernible in 4 to 6 weeks after institution of therapy. Repeated irradiation of bones does not destroy their power to react to androgen. Effective dosage probably requires sufficient amount to render the patient amenorrheic. In many instances a favorable status may be maintained until pulmonary or liver metastases appear when the patient rapidly regresses and dies within a short time despite the continued administration of androgen.

In one case (Case 8) androgen had first appeared to activate the lesions and later to inactivate them.

There appears to be no relationship with the menopausal status and the results of therapy. Four of the patients were still menstruating, 3 were menopausal and the menstrual status of 4 is not recorded. Ages varied between 39 and 62 years.

Undesirable sequelae are acne, facial hirsutism, and deepening of the voice. Increase in libido is noted in many patients.

FRANK B. QUEEN M D

TRACHEA, LUNGS, AND PLEURA

Adenomas Arising from Small Bronchi not Visible Bronchoscopically. Herbert C. Moler and Walter W. Fischer *J Thorac Surg* 1947 16 392

Bronchial adenomas usually occur in the larger bronchi, and can be visualized through the broncho-

scope. The diagnosis is often established by microscopic examination of biopsy material removed endoscopically.

Five cases are reported, in which the tumor was located in a branch bronchus not accessible to the bronchoscope. In each instance, the tumor was large enough to be visible on x ray. Since the tumor did not arise from a large bronchus in any of the cases reported, none of the patients had any history or symptoms of secondary pulmonary suppuration. Three of the patients were asymptomatic, one had several hemoptyses, and one had slight pain in the chest.

In 4 of the cases the tumor was located near the hilar area. These were treated by lobectomy. In the fifth case, the tumor was at the periphery of the lung close to the diaphragm in this case a partial lobectomy was done. All the patients are now well.

Grossly bronchial adenomas are moderately soft, being much softer than the typical carcinoma. Occasionally lobulation is present. The tumor is usually reddish-brown in color. If a portion of the tumor projects into the mediastinum, small veins often cross its surface.

In most instances, a portion of the tumor can be enucleated from the adjacent pulmonary tissue or mediastinal tissues, but there is no cleavage plane in the region of the bronchus of origin. If the tumor projects into an interlobar fissure, it may be noted that when the pleura is divided over the tumor that portion of the tumor which projects towards the adjacent lobe can be readily freed, so that lobectomy is feasible. Pneumothorax is not necessary in cases of bronchial adenoma that are typical and so located that the tumor can be completely removed by lobectomy. In none of the 5 cases reported was there involvement of the regional lymph nodes.

SAMUEL KAHN, M.D.

An Unusual Hamartoma (So-Called Chondroma of the Lung) Morris A. Simon and Harry C. Balloon. *J. Thorac. Surg.* 1947 16 579.

Although small so-called chondromas in the lung are encountered occasionally as incidental findings at autopsy or on routine x rays, the occurrence of relatively large, intrapulmonary cartilaginous masses which produce clinical symptoms is quite uncommon. Usually so-called chondromas vary from a few millimeters to 3 to 4 cm. in diameter but a few tumors varying from 5 to 15 cm. in diameter have been seen. They may be subpleural in position, or may lie near the hilum or elsewhere in the lung. They are firm, dense, tend to be somewhat lobulated, are sharply demarcated, and are gray and glistening on section. The smaller tumors rarely if ever produce clinical symptoms.

These so-called chondromas are not pure cartilaginous tumors, but contain abnormal mixtures of the elements normally encountered in the bronchial wall. They are, therefore, more properly referred to as hamartomas or hamartoma chondromatous polyps.

Although hamartomas of the lung is usually considered to be a benign, slow growing tumor malignant changes may occur. In the case reported, the tumor was of unusual size, produced constant pain and mucopurulent expectoration, and presented a roentgenologic appearance which strongly simulated the usual bronchogenic carcinoma.

SAMUEL KAHN, M.D.

Cupola Tumors. "Ewen-Gösta Sjöberg. *Acta. med. scand.* 1947 143 38.

Over 80 cases of cupola tumors have been described in the literature up to 1942. This type of tumor was first described by Pancoast in 1932. Horner's syndrome first described by Hare in 1838, was based on a case of superior sulcus tumor (cupola tumor).

The author reports 5 cases of this type of tumor: (1) a squamous cell carcinoma, (2) a pleural endothelioma, (3) bronchial carcinoma, (4) bronchial carcinoma. In the fifth case a biopsy was not made. Four of the 5 cases exhibited Horner's syndrome.

One case, that of a bronchial adenocarcinoma, developed entirely above the pleural cupola and, except for a narrow adhesion, was entirely unconnected with the lung. It was also remarkable because of the lack of roentgenographic changes characteristic of cupola tumors. The author prefers this designation because "they are always intimately connected with the cupola pleurae."

Röntgen therapy had a good palliative effect in 3 cases. Unrelenting brachialgia and Horner's syndrome are the most important symptoms.

FRANK B. QUINN, M.D.

Bronchogenic Carcinoma; a Clinicopathological Study of 36 Autopsied Cases Seen at the Brooklyn Cancer Institute between 1927 and 1945, Inclusive. William A. Henkin. *Ann. Int. Med.* 1947 27: 243.

Bronchogenic carcinoma constituted 9 per cent of all malignancies studied at autopsy at the Brooklyn Cancer Institute, Brooklyn, New York. Eighty-eight per cent of the carcinomas were seen in males of a mean age of 55 years.

All primary bronchogenic carcinomas arise from an undifferentiated stem cell located in the basal layer of the bronchial epithelium. The tumor is an adenocarcinoma, a squamous-cell carcinoma, or an undifferentiated or anaplastic carcinoma, depending on the type and degree of differentiation of the original stem cell. Tumors falling into the different histological categories have similar clinical courses, metastasize in a similar manner and show no consistent variations in their response to radiation therapy.

Because different series, classified by equally competent pathologists, show tremendous variations in the percentages of the various histological types, classifications may be regarded as of academic rather than of practical significance.

The earliest and most common symptom, frequently overlooked for months, is a nonproductive

cough. The growing tumor is a foreign body which the bronchus attempts to extrude.

Physical examination and chest roentgenograms show no evidence of the disease in this stage although bronchoscopic biopsy is often possible at this time. In middle-aged individuals wheezing or asthmatic breathing should initiate a thorough search for bronchogenic carcinoma as the growing tumor begins to cause partial obstruction of the bronchus and the segment of lung distal to the affected bronchus becomes emphysematous. Usually the period of emphysema is of short duration and remains unrecognized while the enlarging tumor gradually produces complete bronchial obstruction and atelectasia. If the occluded bronchus is sufficiently large there may be a considerable shift of the mediastinum to the affected side, and a real decrease in functioning lung volume and dyspnea will develop. Almost simultaneously secondary infection develops within the atelectatic segment as necrotic tumor tissue mucus, pus, and bacteria accumulate. Leukocytosis fever and anemia appear. This cycle is responsible for the dangerous diagnosis of "recurrent pneumonia" which has been made too frequently in the face of an advancing malignancy.

Roentgenologic diagnosis is not always easy. A definite diagnosis of bronchogenic carcinoma is made in about 60 per cent of the cases.

In the last analysis bronchogenic carcinoma can be established only by the microscopic examination of an adequate biopsy specimen. In early cases the specimen is obtained either at bronchoscopy or at thoracotomy. In later stages subcutaneous nodules or involved lymph nodes can be biopsied. Pleural fluid may contain cells whose appearance is suggestive of malignancy. Sputum is rarely examined and almost never shows malignant cells when studied by older techniques. However aspiration of bronchial secretions at bronchoscopy and staining by Papanicolaou's method is a procedure which should be performed more often.

The mean and the median life expectancy in this series were only 8 months from the onset of symptoms to death. No patient lived longer than 28 months after the appearance of symptoms.

Treatment is either surgical or roentgenological, or both.

If trained thoracic surgeons are available and there is no discoverable evidence of metastasis, the earliest possible surgical intervention is imperative. Interval roentgen study of a suspicious pulmonary mass or hilar enlargement dooms the case that is suitable for resection.

Every case without metastases or evidence of local invasion of vital structures should have the benefit of an exploratory thoracotomy. Roentgen therapy although merely palliative with the generally available 300 kilovolt apparatus, should be given as early as possible after the determination of nonresectability. Tumor doses above 5,000 roentgens should be administered if maximum benefit is to be derived.

STEPHEN A. ZIEGLER, M.D.

Primary Carcinoma of the Lung, with Invasion of the Ribs. Frank Philip Coleman. *Ann Surg* 1947 126 156

Osseous invasion is present in probably between 5 and 10 per cent of all patients with carcinoma of the lung. The majority of the pulmonary carcinomas which secondarily invade adjacent ribs or vertebrae are of the squamous cell type. The author describes the case histories of 6 patients in whom such squamous cell tumors were observed. Pericostal invasion of the soft tissue of the chest wall without osseous extension had occurred in an additional patient in whom the tumor was an adenocarcinoma.

Peripheral pulmonary squamous cell carcinoma invades contiguous structures grows slowly and metastasizes late in the course of the disease. Because of this favorable pathologic behavior it is emphasized that adjacent rib invasion does not relegate carcinomas of this type into the group of incurable tumors. Block excision of the chest wall leaving a margin of healthy tissue attached to the involved structures plus total pneumonectomy and excision of the regional lymph nodes is the desired treatment in such cases.

Other than pain there are few symptoms until late in the course of the disease. Tenderness over the affected rib is usually present. Rib destruction is revealed by over-exposing the roentgen films. Direct biopsy of the rib will establish a tissue diagnosis but it carries with it the danger of soft tissue implantation in apparently operable patients.

Exploratory thoracotomy is the method of choice in selected cases for determining tissue diagnosis and operability. The pleural cavity is entered a rib and a full rib interspace below the lesion. Involvement of the brachial plexus, sympathetic trunk, phrenic nerve or the transverse processes of the vertebrae contraindicate curative surgical attempts but palliative resection may be considered in view of the associated severe pain.

Five of the 7 patients whose cases are reported by the author were subjected to block excision of the chest wall and pulmonary resection. A total pneumonectomy was carried out in 4 patients and a palliative lobectomy in 1 patient. There was one operative death, and the patient with the palliative lobectomy lived for a period of 11 months. The 3 remaining patients are living and well—one 6 years one 2 years and one 5 months after operation.

ORVILLE F. GARDNER, M.D.

Sequelae of Pneumotomy (Séquelles de pneumotomie) Marc Iselin. *Helvet chir acta*, 1947 14 147

Recent advances in chemotherapy have rendered pneumotomy almost superfluous as a treatment for lung abscess. However some cases fail to respond to penicillin, and pneumotomy may save the patient's life if not too long delayed. The mortality rate of this operation is estimated at about 25 per cent but it is due to the sequelae of operation rather than to the intervention per se. Poor results of the operation are notably diminished if it is performed in

the earlier stages, before the development of chronic disease. Among the lesions responsible for nondrains following pneumotomy may be mentioned bronchial fistulas, residual pulmonary cavities, bronchial dilatations and pyocarcinosis.

The surgical pathologic anatomy of these complications is discussed at length including that of the skin wound and surrounding bone structures. Frequently multiple cavities are present before the pneumotomy and may require repeated pneumotomy via the same or other routes for final obliteration. In the case of symptomatic fistula, treatment must be directed to the cause whether this be multiple abscesses, bronchial dilatations, or abscesses superimposed on bronchial dilatation or pyocarcinosis. For residual fistula, muscle flaps from the vicinity may be used to fill the cavity. In untreated symptomatic fistula death usually ensues within 2 years from chronic suppuration, pneumonic phases, secondary hemorrhage or cerebral abscess. In residual fistula the chief danger is from secondary hemorrhage which may cause sudden death. Even though the fistula is apparently well tolerated, its elimination is imperative. Differential diagnosis includes elimination of tuberculosis and cancer. In symptomatic fistula, tomography and bronchography will reveal the condition of the lung and bronchi. Roentgenoscopy at frequent intervals is a valuable diagnostic aid. In residual fistula a lipiodol bronchogram is necessary to ascertain the condition of the bronchial tree.

The surgical methods of treatment in order of increasing importance are as follows: débridement of the wound, repeated pneumotomy, plastic muscle flap operation, and lobectomy or pneumonectomy.

Symptomatic lesions must be treated in as rapid sequence as possible, only enough time being left between the operations for the reaction from the last to subside. Collaboration of the physician and surgeon in this respect is most important.

The choice of procedure will depend upon the lesions found. In the presence of a retracted wound with retention and hemorrhages, débridement under local anesthesia is indicated with incision of the scar tissue and liberation of the fibrous bands binding the skin to the deeper tissues. During operation poorly exposed cavities may be discovered and may require incision or even additional rib resection. Following wide exposure, the wound may be powdered with septolix and packed with gauze. Débridement was done 17 times in 13 patients, and 3 times in 1 patient. Repeated failure of this procedure is one of the major indications for the plastic muscle operation.

A secondary abscess close to the pneumotomy wound may be approached through the same incision following débridement. If the abscess is at a distance from the original wound a new approach may be required. In 1 case as many as 4 incisions had to be made. In the attempt to open an abscess once it is located great care should be employed to keep trauma to the lung tissue at the minimum. "Cuneo-resection" with the thermocautery or electric bistoury too often involves trauma which leads to a fatal issue.

Should parenchymatous and bronchial suppuration persist, excisional or typical lobectomy is indicated if the general condition of the patient permits. Because of the pulmonary breach, an aseptic intervention is impossible and the operation is rendered still more difficult by the presence of regenerated bone and adhesions. Medical treatment is therefore recommended in these cases, and at least 1 patient who was believed lost was saved by this method.

In cases of fistula or residual cavity a pedicled muscle flap from the vicinity may be used to fill the bronchial orifices, but this procedure is merely palliative and cure will not be complete if bronchial dilatation persists. Only 1 death was attributed to this type of treatment. The radical procedure for these lesions consists in lobectomy which at present, with the aid of penicillin, permits complete cure in 3 weeks. Because of parietal changes this operation is difficult and dangerous. Adhesions are usually dense, the pneumotomy wound may be placed inconveniently and, if more than 2 rib segments are wanting, the incision may be difficult to close. Diffuse induration may be discovered beyond the planned field of operation which necessitates a pneumonectomy. In such cases a prompt decision is imperative if the life of the patient is to be saved. Too much blood and time may be lost in performing a futile lobectomy.

If the general condition is good the operation may be selected according to the anatomic findings; if not, no major operation can be attempted until proper measures have been instituted to strengthen the patient.

The pedicled muscle flap is indicated in tuberculous lesions in which excerals might lead to dissemination of the bacilli. The residual fistula ordinarily left after this procedure will close in time. When the cavity is larger than a small fist, muscle transplantation will not suffice. In 1 case, healing took place after repeated plastic interventions over a year and in another similarly treated case the bronchial fistula persisted but its caliber was greatly diminished. Complete success was obtained in 2 cases in which lobectomy was done in the first place.

Lobectomy of the upper lobe is extremely difficult and dangerous, whereas the plastic operation employing a pedicled muscle flap yields good results. In lower lobe and lateral lesions, excerals is preferable.

For a successful plastic operation, the fistula must be permeable both on inspiration and expiration. Otherwise emphysema and purulent effusion may develop following operation in spite of the use of penicillin.

Other conditions permitting excerals is indicated when bronchial dilatations are found in the vicinity of the residual cavity or at a distance from it. In their absence and barring other contraindications, the plastic operation is preferable. These indications will, of course, be influenced by the constant advances being made in the technique of excerals with diminished chances of hemorrhage and shock. The strongest argument against excerals is the impossibility of

locating lesions before operation so that pneumonectomy may be required where lobectomy was planned. Advances in chemotherapy permit an earlier evaluation of the probable results of medical treatment so that when failure appears imminent a pneumonectomy can be done at a stage when the mortality and morbidity of this operation are still low and good results can be expected.

EDITH SCHANCHE MOORE.

The Use of Prostheses to Prevent Overdistention of the Remaining Lung following Pneumonectomy
Julian Johnson, Charles K. Kirby, C. S. Lazatin, and J. A. Cocke. *Surgery* 1947 22 179.

The clinical experience and experimental work of these authors indicate that it would be desirable to prevent mediastinal shift following pneumonectomy and thus avoid overdistention of the remaining lung. This can be accomplished by an extensive thoracoplasty. In the presence of infection the thoracoplasty must be done. In the absence of infection it is desirable to use some method which is less extensive than a thoracoplasty whereby overdistention of the remaining lung can be prevented.

It is suggested that a noncompressible prosthesis may be introduced into the pleural cavity at the time of pneumonectomy as a means of preventing postoperative mediastinal shift and overdistention of the remaining lung.

Two types of prostheses have been studied in the dog: (a) a solitary large hollow metal prosthesis of zirconium, and (b) multiple small hollow plastic balls of methyl methacrylate (lucite).

The studies made indicate that hollow balls of methyl methacrylate (lucite) make a satisfactory filling material to place in the pleural cavity following pneumonectomy. They cause minimal reaction in the pleura and offer a convenient means of filling pleural cavities of various sizes.

STEPHEN A. ZIEGLER, M.D.

HEART AND PERICARDIUM

Anomaly of Aorta Simulating Mediastinal Tumor
David B. Corcoran and Frank Philip Coleman.
J. Thorac. Surg. 1947 16 427.

Röntgenologic examination is the most important method of diagnosis of solitary tumors of the mediastinum. It offers valuable information pertaining to the type of the tumor by localizing the mass, revealing its relationship to adjacent structures, and by establishing the presence or absence of pulsation. Diagnostic roentgen therapy also plays a role in the differential diagnosis in certain cases, by determining radiosensitivity.

A case of unusual interest is reported in which a unique anomaly of the aorta, simulating a mediastinal tumor was found.

SAMUEL KAHN, M.D.

Complete Division for the Patent Ductus Arteriosus.
Robert E. Gross. *J. Thorac. Surg.* 1947 16 524.

A follow up study of 43 patients who were treated by various types of ligation 'in continuity' for



Fig. 1 (Johnson et al.) A dog sacrificed 3 months after left pneumonectomy and introduction of 24 one inch lucite balls into the pleural cavity. The right lung was not overdistended. There was just enough fluid present to fill the space between the balls (35.0 c.c.) There was minimal reaction of the pleura.

patent ductus arteriosus shows that 80 per cent of the patients obtained complete closure of the ductus. In about 10 per cent of the cases the fistula was re-established when the ligatures apparently cut partially through the ductus. In the remaining 10 per cent, the ligatures were not tied tightly enough so that a small shunt persisted at the close of the operation. Most of the patients were benefited because the work of the heart was tremendously decreased and in some cases a streptococcus viridans infection was permanently cured. However permanent closure of the shunt can only be assured by complete division of the ductus.

An anterior approach is made, and the third inter-space is utilized after the second and third costal cartilages have been divided. The superior mediastinum is incised longitudinally one half inch posterior to the phrenic nerve. The vagus and left recurrent laryngeal nerves are spared from injury. Lymph nodes fat and areolar tissue must be cleared away from the aortic arch and the pulmonary artery so that the intervening ductus can be clearly visualized. After the ductus has been freed of areolar tissue and has been cleared of any investing membrane, four clamps are applied and the ductus is divided between the middle two. The clamps used are standard Crile clamps 3/4 inches in length the jaws of which

have been ground off on both sides so that the surfaces are nearly parallel and the jaws thinner than those of stock instruments.

The pulmonary side of the ductus is closed first. The presenting clamp (the one nearest the operator) is removed thus providing a small cuff of ductus wall 2 or 3 mm. in length. This cuff is sewn over and over with a continuous 5-0 Deknatel silk suture carried on a small atraumatic needle. The aortic cuff produced by removing the uppermost clamp is treated in a similar manner. A second row of adventitial sutures is unnecessary.

After the pulmonary and aortic ends have been sutured a gauze sponge is inserted into the interval between the pulmonary artery and the aorta and the remaining pulmonary clamp is removed. The pack is held in place several minutes to allow blood to coagulate between the intima of the sutured end of the ductus. The aortic clamp is removed similarly. Only in a few cases is it necessary to apply additional sutures. The mediastinum is closed by repairing its parietal pleura with interrupted silk sutures.

Complete division of the ductus arteriosus has been carried out in 90 patients ranging in age from 2 to 46 years. There were 2 surgical deaths—one 2 weeks after operation from an overwhelming staphylococcal mediastinitis, the other in a 26 year old female with advanced cardiac decompensation.

Complete division is especially indicated in adults beyond 18 to 20 years of age. The ductus is frequently unyielding, is difficult to compress, and has an exaggerated pulsation transmitted to it by a sclerotic and fixed aorta. Under such circumstances ligation in any form will occasionally lead to a partial recurrence of the fistula. Even in infants, the author believes that complete division is the superior method although it is admitted that in children in whom the ductus is soft, yielding, elastic, and easily compressible, ligation can almost always be relied upon to produce a permanent closure. Complete division of the patent ductus has been so completely satisfactory that the author has abandoned all forms of ligation of the vessel. ORVILLE F. GRIMES, M.D.

Complications of the Surgery of Patent Ductus Arteriosus. John C. Jones. *J. Thorac. Surg.* 947 161 305.

Complications of the surgery of patent ductus arteriosus in a series of 61 successive patients are reviewed. In 53 of the cases the ductus was ligated in continuity, in the remaining 8 it was divided and sutured. Virtually all patients developed post-operative effusions, but in only one third of the cases was aspiration deemed necessary. Atelectasis occurred in 5 patients, each time in the left lower lobe. Left recurrent nerve paralysis occurred in 3 patients. It was persistent in 2 patients, and in patient recovery was noted within a few weeks after operation. Two of the patients developed empyema thoracis, preceded by pneumonia in only 1 patient.

There were no wound infections. The anterior approach utilizing the second interspace has been

abandoned because of the high incidence of keloid scars. A posterolateral incision with resection of the fourth or fifth rib is recommended.

Sudden copious hemoptysis was a serious complication in 2 patients whose case histories are recorded. Both patients, aged 35 and 11, had repeated episodes of gross hemoptysis. One patient remains well after exhibiting hemoptysis of varying degree for a period of 7 months, and occasional streaking of the sputum for a further period of 15 months. Exploratory thoracotomy performed on the 11-year-old patient revealed an aortobronchial fistula resulting from erosion by the silk umbilical tapes used in ligating the ductus. In both patients the ductus has remained closed. Since this experience the mediastinal pleura has been closed in all cases so that the knots are buried to protect the mediastinal aspect of the upper lobe. The latter procedure, however, will not prevent erosion of the aorta or possible aneurysm. Such a complication is considered an argument in favor of complete division of the ductus arteriosus.

There were 2 deaths in the series—one from Staphylococcus aureus endocarditis 48 days following ligation. In the first case, autopsy revealed a re-established fistula between the pulmonary artery and the aorta, and an aneurysm of the ductus. The ligatures had cut through the wall of the ductus, and a superimposed blood stream infection resulted in vegetations on both the pulmonary artery and the aortic wall. The other death was an operative mortality from cardiac arrest occasioned by a considerable loss of blood at a rapid rate. At autopsy cardiac pathology consistent with that found in rheumatic fever was revealed.

Failure to tie the tapes tightly enough to occlude the lumen of the ductus completely is the probable explanation of the failure to obliterate the continuous murmur which occurred in 5 cases. In 5 other cases, a recurrence of the continuous murmur detected from 5 to 6 weeks after surgery is explained by re-establishment of the fistula after the tapes had partially cut through the walls of the ductus.

ORVILLE F. GRIMES, M.D.

Bullet Wounds of the Heart (Heridas de bala del corazón). Leonidas Aguirre Mac Kay Arch. Soc. Med. Santiago 1947 3 393

This article records the experience of the emergency service for the City of Santiago de Chile between 1933 and 1945 (13 years). Fourteen patients with bullet wounds of the heart were treated with 3 survivals. One of the 14 patients was not operated upon.

The subject of heart wounds is briefly reviewed with ample use of tables to illustrate the types of wounds, other associated wounds, the age, sex, state of sobriety, and the length of time elapsed between the wounding and the operation. These tables are taken not only from the material under discussion, but from records of the Medicolegal Institute and from the literature. No significant details of tech-

nique are included beyond illustrations of several accepted surgical approaches.

A case is reported in which a heart wound produced by a bullet was successfully sutured

HIRAM T. LANGSTON M.D.

Heart Catheterization. A. L. Johnson D. G. Wollin, and J. B. Ross. *Canad. M. Ass. J.*, 1947 56 249.

The importance of more exact diagnoses of congenital heart lesions has been emphasized by the advances which have been made in surgery for congenital heart defects. Heart catheterization has been used by the authors in 17 children ranging from 19 months to 16 years. By this method all four heart chambers and the pulmonary artery and vein have been entered.

Forsmann in 1929, is credited with the first heart catheterization but it was not until the work of Courmand and Ranges in 1941 that its many possibilities were recognized. Brannan, Dexter and Baldwin also have reported recent works on this subject.

A ureteral catheter is introduced through a nick in the antecubital or saphenous vein. It is a special catheter with a curve in the distal end. This gives the operator some control in directing the tip. Under fluoroscopic control the catheter is passed into the right auricle, the right ventricle and pulmonary artery.

Either arm may be used but the catheter seems to pass more readily past the origin of the innominate vein on the left. A slow drip of saline through the catheter keeps the lumen patent. Blood samples or pressure readings are taken through a three way stop cock. The patient should be heparinized at the start of the procedure and a clotting time of 10 to 20 minutes is maintained for 24 hours afterwards. From 5,000 to 10,000 units of penicillin are given intramuscularly every 3 hours for 48 hours. Mean pressure readings are taken with a saline manometer and Tyco's dial. Blood samples for oxygen determinations are withdrawn under oil and run by the Van Slyke method. An x-ray picture is taken at every site at which a blood sample is withdrawn. At the conclusion of the procedure blood is withdrawn from the femoral artery for an oxygen consumption determination with use of the Benedict Roth apparatus.

Morphine and scopolamine and a barbiturate were used for preoperative medication. Intravenous morphine and avertin or pentothal were used as anesthetics in children under 3 years of age. The older children needed no anesthesia.

This method is safe as some 1,200 procedures have been carried out without a fatality. No arrhythmias other than occasional extra systoles have been reported. The authors had one patient who developed paroxysmal tachycardia during the procedure. Only occasional slight thrombophlebitis of the brachial veins has been reported. One of the authors' patients, a 19 month old sickly infant, died 1 month

after heart catheterization. A clinically unsuspected organized thrombus of the inferior vena cava, right renal vein, and both common iliac veins were present, as well as a large thrombus attached to the right auricular wall.

Of the 17 patients 4 were cyanotic, 9 were considered to have interventricular septal defects, none were cyanotic in 1 patient the persistence of a left superior vena cava was demonstrated.

Arterialized blood in the right ventricle or blood with a significantly higher oxygen content than that found in the right auricle is evidence of a ventricular septal defect. The case reports and x rays of several examples are given.

An example of a patent ductus arteriosus and 2 cases of auricular septal defects are discussed.

In some instances, placing the catheter under fluoroscopic vision enables one to estimate the size of the ventricles or auricles.

Based on their limited experience and on the few cases in the literature, the authors believe that heart catheterization appears to be a useful adjunct to the investigation of congenital heart disease.

ROBERT R. BICKLOW M.D.

Traumatic Pneumopericardium (Le pneumopéri-cardé traumatique) Eric Nègre *J. Chir. Par.*, 1947 63 307

Traumatic pneumopericardium produces its characteristic clinical syndrome of cardiac compression in addition to those symptoms which usually accompany all penetrating thoracic or thoracoabdominal wounds. In many instances the elements of the compression syndrome are not easily recognized in the complex picture of shock and acute anemia.

The pathophysiology of pneumopericardium is dependent upon the compressibility of gaseous substances and upon the exceptional faculty of the pericardium for resorption, which is superior to that of other serous cavities. However, intrapericardial gas may be under considerable tension as in the case of hemopneumopericardium or of gas bacillus infection in which gas is continually produced in a nonextensible chamber. In the latter 2 instances the symptoms of cardiac compression rapidly ensue.

The compression syndrome of pneumopericardium is manifested by both respiratory and cardiovascular distress. Dyspnea is constant and respirations are rapid, short, and superficial. Anginal type of pain is common. Tachycardia, fall in arterial tension, increased venous pressure, deathly cyanosis or pallor of the face and turgescence of the jugular veins completes the picture of compression. A precordial zone of tympany may sometimes be found but in most cases an intrapericardial or mediastinal outpouring of blood will mask such a sign. The roentgenological examination will confirm the existence of pneumopericardium alone or in association with a hemopericardium.

Pure pneumopericardium is rare and when present is produced by a rather small cutaneous wound with a short course directly to the pericardium. The more

segments were resected up to the chondrosternal cartilage of the ribs three fourths or four fifths of which had previously been resected via the posterior paravertebral route. In a very few cases these anterior segments were resected before the posterior segments. Usually the transverse apophyses of the second third fourth, fifth and sixth ribs were resected. Apicolysis was added in some cases following the bony resection.

The mortality rate during the second five year period was greatly reduced probably because of advances in bronchology anesthesia blood banks, as well as in radiologic and surgical technique.

Fifteen patients died following the first stage of the operation. Of 9 patients dying after the second stage, 1 had previously been operated on the contralateral side. Of 4 who died after the third stage, 1 had already been subjected to two stages on the other side. Twelve deaths were attributed to operative shock, and occurred early in the series before the day of blood banks and bronchoscopic drainage. Intratracheal anesthesia has also served to reduce the mortality. Other causes of death included bilateral parenchymatous reaction, homolateral reaction, contralateral reaction, secondary empyema, and infection of the wound as well as accidental injury of the parietal pleura and empyema, fulminant hemorrhage from the wound anesthetic shock before the fourth stage secondary uremia, and incompatibility of the transfused blood.

Patients of the third or fourth class are more likely to have residual caustics even after several stages of thoracoplasty. However a number of patients survived and some were even able to resume their occupation.

Of 303 patients surviving operation 197 or 50.3 per cent, are living and of these, 131 patients or 30.6 per cent, are working. Thirty four or 10.3 per cent, are at home either because they are afraid to go back to work or because they are still suffering from

tuberculosis of one form or another. Thirty-two patients or 0.6 per cent, are still hospitalized, and 77 patients have died from the results of operation or spread of the disease to the other lung or other organs. In many cases in which work was resumed too early the disease spread to the other lung. The patients died of causes not related to the operation or tuberculosis. Fifty-three patients or 15.7 per cent, could not be traced.

The series of 58 cases of tuberculous empyema was divided into two classes, the good risks being those presenting a restricted pleural space with no detachment in the upper fourth, no evident bronchopleural fistula, and no marked pachypleuritis. Only 36 per cent of the series belonged in this class. It was noted that artificial pneumothorax had been employed in 35.60 per cent, of the 58 cases in which tuberculous empyema developed. Thoracotomy for drainage as necessary in 30 cases or 51.7 per cent. Extrapleural thoracoplasty sufficed in 33 cases. Thirty patients were subjected to a Schede thoracoplasty. Following resection of a portion of the parietal pleura, the infected pleural cavity was curetted. This intervention causes considerable surgical shock which may be difficult to control.

In 12 cases two types of thoracoplasty were done in the different stages. In some cases it was necessary to use a musculoaponeurotic graft to fill the pleural cavity.

The mortality of these patients without thoracoplasty was very high. Nevertheless, in 1945, 35 per cent of the patients were not only alive but working. The operative mortality rate was 15.5 per cent. Seventeen other patients have died subsequently and 8 could not be traced.

It is evident that thoracoplasty is the only successful treatment for certain types of tuberculosis of the lungs and pleura. The risk is slight and many patients recover and can resume work.

EDITH SCHAEFER MOORE.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Femoral Hernia with Gangrenous Bowel Clarence
Dennis and Richard L. Varco *Surgery* 1947 22
312.

The published mortality rates for strangulated femoral hernia are high. Only one report in the literature mentions a mortality rate as low as 25 per cent. The authors believe that the high mortality statistics are due mainly to the conventional method of exposing and opening the hernia sac either by externalization or resection and primary anastomosis in the contaminated field.

An alternative method of management is presented. Preoperative attention is directed toward re-establishing correct water and electrolyte balance. Gastric suction is instituted. Although the lapse of a few hours might increase the likelihood of frank gangrene in the strangulated bowel it is wiser to attend to the altered fluid state.

With the use of local block anesthesia, a vertical incision is made over the bulge in the groin and cautiously carried down to the peritoneal sac. The contents of the sac can be visualized through the remaining wall. Should gangrenous bowel be recognized, dissection in this area is discontinued and an incision is made 2 centimeters above the inguinal ligament and parallel to it. The vertical line is continued upward to form a T-shaped incision. The incision is developed and the peritoneum is opened parallel with the oblique skin incision. From this vantage point, the viscera entering the hernia may be readily identified. If omentum is involved it is easily divided and ligated close to the neck. If gangrenous small bowel is present in the sac, Ochsner clamps are placed across the two limbs and the bowel is divided between each pair with the canter. The inguinal ligament is then divided and split laterally leaving enough aponeurotic tissue applied to the neck of the sac to prevent relaxation of the neck and release of the soiled content. The entire contaminated area can then be removed intact without soiling of the operative field (Fig. 1). Primary end-to-end anastomosis of the limbs of the bowel can then be accomplished.

Closure of the peritoneal defect in the repair of the hernia is easily accomplished because of the mobility of the peritoneum in this area. The margins of the internal oblique and the transversus muscles are sutured to Cooper's ligament as far lateral as the femoral vein and to the inguinal ligament lateral to that point. The inguinal ligament is restored by approximating it without tension to the lacunar ligament and to Cooper's ligament.

The importance of avoiding contamination is paramount. By recognizing the state of the contents through the intact hernial sac, contamination of the operative field is prevented. Experimentally it has

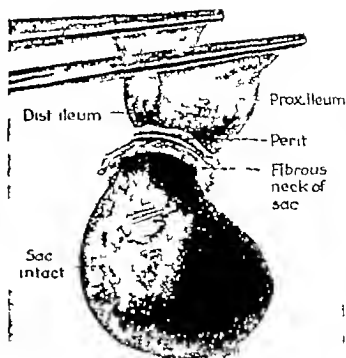


Fig. 1 (Dennis and Varco) Sac removed

been shown that the abdominal fluid and venous blood in cases of strangulating obstruction contain depressor substances. It is therefore important to resect the gangrenous segments of intestine without releasing the neck of the sac.

The authors defend their sectioning of the inguinal ligament by stating that the repair as indicated has been successful in their hands. Closed aseptic end-to-end anastomosis is recommended.

The authors present 10 cases in which this plan of management was carried out. Two patients have died, one of cardiac failure and the other of a ruptured aortic aneurysm. The other patients are living and well. One patient developed a recurrence as a direct hernia 2 years after repair.

ORVILLE F. GRIMES, M.D.

GASTROINTESTINAL TRACT

Effect of Enterogastrons on Mann-Williamson
Ulcers in Dogs. H. C. Saltzstein, David J. Sand-
weiss, John M. Hammer, Edward J. Hill, and
Henry J. Vandenberg, Jr. *Arch. Surg.*, 1947 55
135

In this study the authors attempted to evaluate the effect of orally administered enterogastrone on a series of 15 dogs in which jejunal ulcer had been produced by the Mann-Williamson operation. At

the time of this report the average survival time in the enterogastrone series was 96 days while that of the control series was 71 days. The longest survival time in the enterogastrone series was 59 days, while that of the control series was 135 days. The shortest survival time in the enterogastrone series was 25 days compared with 53 days for the control group.

Eleven of the enterogastrone treated dogs died with jejunal ulcers with an average survival time of 97 days. Of the 11 dogs with jejunal ulcer, 10 had perforated ulcers and generalized peritonitis which accounted for death.

In the control series all of the dogs showed ulcer at autopsy and in 73 per cent the ulcer had perforated.

Therefore, it is concluded that oral enterogastrone has some beneficial therapeutic effect on experimental Mann-Williamson ulcers in dogs.

HAROLD LAUFMAN, M.D.

Effect of Vagotomy on Mann-Williamson Ulcers in Dogs. H. C. Saltzstein, David J. Sandweiss, John M. Hammer, Edward J. Hill, and Henry J. Vandenberg, Jr. *Arch. Surg.* 1947 55 130.

While 28 control dogs survived the Mann-Williamson operation for an average of 71 days, 13 dogs on which vagotomy plus the Mann-Williamson operation were performed survived only 51 days after the Mann-Williamson operation and 44 days after the vagotomy. Of the controls, 100 per cent showed ulcer at autopsy. Seventy-two per cent of these died of perforation with peritonitis. Among the vagotomized animals, jejunal ulcers developed in 6 of the 8 that lived more than 1 month after the Mann-Williamson operation. An inflammatory reaction of varying severity was found in the upper part of the jejunum in 7 of 13 dogs on which Mann-Williamson operations and vagotomy were performed. There was no correlation with the survival time. Gastric dilatation was present in 9 of the 13 dogs.

It is therefore concluded that vagotomy does not have a favorable effect on the ulcers produced by the Mann-Williamson operation. Since jejunitis was present in 60 per cent of the vagotomized dogs it is suggested that it may be an explanation for the diarrhea following this operation.

HAROLD LAUFMAN, M.D.

Resection of the Vagus Nerves for Ulcer; An Interim Evaluation. Operative Technique and Hospital Management. Francis D. Moore. *Arch. Surg.* 1947 55 104.

In this article the author outlines the technical procedures which he employs in vagus resection for ulcer as well as the hospital management of patients. Eighty-seven per cent of the author's 83 patients had good results and are well satisfied with their operation from 3 to 30 months postoperatively. Five patients had a frankly poor result either with a demonstrable recurrence or symptoms of ulcer. Five other patients had sufficiently severe side effects, consisting of diarrhea or other gastrointestinal manifestations, to detract materially from their satis-

faction with the result. All but 1 of the authors' patients were operated on through the thorax. Only 3 postoperative posterior gastroenterostomies have been necessary. Of 73 patients who underwent thoracic operations, 40 had no discomfort of the chest after the first few postoperative days, 31 had minor discomfort and 3 had major chest or intercostal pain.

The postoperative management extends through the first 3 postoperative months and consists essentially of giving the stomach an easy mechanical job to perform and allowing it a complete 12 to 16 hour rest if the presence of fullness or diarrhea indicates some defect. Many patients who have been untidied over a bout of motility symptoms have remained well subsequently. The author believes that although there is a strong temptation to carry out gastroenterostomy under these circumstances, it can usually be avoided.

The 19 patients in this series who had gastroduodenal stomas either primary or secondary had the same incidence of diarrhea and fullness as the series of patients with duodenal ulcer. This is another reason for not performing gastroenterostomy routinely. As treatment for frank obstruction it is usually effective as a means of avoiding gastrointestinal side effects. It is ineffective. The author describes his technique for the thoracic approach to the vagus nerves.

If care is taken in dietary management, the prolongation of hospitalization due to poor emptying of the stomach need only constitute a minor problem. The prevention of pulmonary complications involves early ambulation, the use of blow bottles, encouraging the patient to cough and to take deep breaths, and moving the patient freely in bed. To prevent postoperative dilatation of the stomach the author gives less than 1 ounce of liquid per hour for 3 or 4 days. The diet is then cautiously increased with daily aspirations of the stomach. The diet is "wet back" if a significant residue forms. The author leaves the Levine tube in place on suction for 48 hours in most cases. The patient is never discharged from the hospital following transthoracic vagotomy prior to the twelfth day.

By performing gastroenterostomy as rarely as possible the author hopes to be able to better evaluate the therapeutic effect of the vagus resection. The routine performance of gastroenterostomy with each vagotomy confuses the therapeutic effect, since gastroenterostomy in itself has such an effect in most instances.

HAROLD LAUFMAN, M.D.

Section of the Vagus Nerves to the Stomach in the Treatment of Benign Gastric Ulcer. Paul V. Harper, Jr., and Lester R. Dragstedt. *Arch. Surg.* 1947 55 114.

This article pertains to the treatment of patients with benign gastric ulcer by section of the vagus nerves. The rationale is based on the following considerations:

When the lesion is in the pyloric antrum and readily accessible it is probably treated best by a sub-

total gastrectomy however when the lesion is high on the lesser curvature close to the treatment of a resection extensive enough for the esophagus, a possible malignancy would involve a total gastrectomy. Total gastrectomy is much more hazardous than partial gastrectomy and the resulting digestive and nutritive defect constitutes a definite disadvantage. When these facts are taken into consideration, together with the small percentage of gastric cancers that can be cured by any type of surgical treatment, the authors believe a total gastrectomy is not justified in the absence of a total gastrectomy of malignant growth.

Of the authors group 250 cases of peptic ulcer treated by vagotomy 8 were cases of gastric ulcer. Among these were 3 in which there was a coexistent active duodenal ulcer. In such cases the possibility of malignant growth is generally believed to be about 1 per cent. Therefore when cases of combined gastric and duodenal ulcer are refractory to medical management, the authors believe that vagus section is indicated. In 3 such cases, healing took place extremely rapidly with no recurrence of symptoms. In 3 other patients in this series large chronic gastric ulcers were present high on the lesser curvature of the stomach. These were refractory to medical and x ray therapy. Subtotal gastrectomy as a method of treatment had been refused. In all 3 cases the ulcers healed promptly after vagus nerve section. All these patients remained well 1 year for more than 3 years and 1 for more than 3 years.

The 3 remaining patients in this series also had chronic gastric ulcers high on the lesser curvature but a differential diagnosis between benign gastric ulcer and carcinoma could not be made even with the aid of laboratory studies, roentgen examination and gastroscopic observation. Palpation and inspection of the lesion at laparotomy were also not decisive. A type of therapeutic test vagus nerve resection was done. Although there was complete symptomatic relief in both cases the ulcers failed to heal. Total gastrectomy was therefore advised.

The authors are of the opinion that unless the diagnosis of malignant growth is certain gastric ulcers high in the stomach should be treated by vagotomy. If the lesion is benign section of the vagus nerves may bring about prompt healing in cases that have proved resistant to intensive medical management. On the other hand if healing does not occur within a period of from 4 to 6 weeks the surgeon has additional evidence for the belief that the lesion is malignant and can undertake a total gastrectomy with a better conscience.

HAROLD LAUFMAN M D

Clinical Evaluation of Complications Observed after Transphrenic Vagotomy K. S. Grimson G. J. Baylin H. M. Taylor F. H. Heuser and R. W. Rundles. *Arch. Surg.* 1947 55 175

Fifty-seven patients with refractory or frequently recurring peptic ulcer were treated by transphrenic vagotomy or transphrenic vagotomy plus gastro-

enterotomy. The persistence in using the transphrenic approach is explained by the assumption that it minimizes the chance of incomplete operation or of regeneration. The result obtained by questionaire office visits and re-examination in the hospital indicated that of 56 surviving patients are completely satisfied 27 are almost completely satisfied and 7 are only partially satisfied while 1 was dissatisfied because of an exacerbation of a pre-existing gastrointestinal disturbance with vomiting and diarrhea. This patient died 2 years after vagotomy and gastroenterotomy due to rupture of the stomach after an acute gastric dilatation and terminal massive hemorrhage from a jejunal ulcer. The greatest difficulty has been occurrence of obstruction at the outlet of the stomach with retention of the gastric contents and dilatation. Obstruction is usually due to abnormal function of the outlet of the stomach after removal of vagal control. Obstruction and retention have necessitated secondary gastroenterotomy in 5 patients from 11 to 105 days after transphrenic vagotomy. Two other patients with serious symptoms as the result of retention are being treated with partial success by parasympathetic drugs.

Thirty-six patients were subjected to transphrenic vagotomy alone. Of these only 9 were completely satisfied with the results of the operation. Reasons for dissatisfaction consisted of vomiting during the first several months (3 cases), recurrent severe abdominal pain (3 cases), severe pain (3 cases), melena, a sensation of fullness after eating, 18 instances of foul eructations during the first 3 months with the persistence of these eructations in 10 patients. Of the 36 patients without gastroenterotomy 20 who had been previously constipated had normal bowel habits after vagotomy while 4 had moderate constipation. In 11 cases there was a continuous or periodical looseness of stools, and in 1 case a serious diarrhea.

Of 21 patients who had gastroenterotomy before, at the time of or after vagotomy 6 had marginal ulcers occurring after subtotal gastric resection 3 enterostomy after gastroenterotomy 3 gastroenterotomy just before vagotomy, 5 gastroenterotomy after vagotomy. Of these 20 patients only 12 were completely satisfied 5 almost completely satisfied 5 almost completely dissatisfied. Unexplained serious episodes of colicky pain occurred in 3 patients. One of them had a stomal ulcer and nonfunctioning gastroenterotomy 3 months after vagotomy. In 13 of these 20 patients there was a sensation of fullness after eating during the first 3 months after vagotomy and this persisted in 6. The author found that vagotomy may be of value when combined with gastroenterotomy or when employed for stomal ulcer. He does not believe that transphrenic vagotomy alone should be used as standard treatment.

HAROLD LAUFMAN M D

Partial Gastrectomy for Simple Ulcer. A. D. Watson. *Brit J Surg* 1947 34 353

A follow up study of 138 patients who had undergone partial gastrectomy for simple ulcer was carried out in an effort to determine whether the results justified the operation. In the course of this study some undesirable side effects of the Polya operation were seen which led to criticisms of this type of anastomosis. None of the patients had been operated upon less than 6 months previously. The results of the follow up are considered under the following headings: (1) clinical and functional result, especially in connection with the length of the loop and the width of the stoma; (2) the fractional test meal, with particular reference to the operation of pyloric exclusion; and (3) anemia.

The general impression gained from talking to these patients is that the operation of partial gastrectomy is definitely worth while, and this impression is confirmed by the statistics. The average period of convalescence after operation has been from 3 to 4 months. Most of the workers have returned to their original employment and have not lost time from it since. A number of the patients have failed to increase their weight to their preillness level but despite this, no increased liability to ill health was noticed. Only 3 patients had abnormal appetites, one being more, and the other less, hungry than normal. When interviewed, the majority were eating normally. The functional result or the present subjective state of the gastrointestinal tract, was as follows: excellent in 40 per cent, good in 43 per cent, improved in 11 per cent, and not improved in 3 per cent. In 23 per cent of the cases there was a recurrence.

The following features were common to the three cases of recurrence: the patients were all males; the original lesion was a duodenal ulcer; the anastomosis was full width and antecolic; and there was no x-ray or clinical evidence of afferent loop obstruction. These 3 cases support the common belief that duodenal ulcers are more likely to lead to recurrent ulceration and that free acid is only a predisposing factor to ulceration. All cases of recurrence were of the long loop antecolic type. The recurrence rate therefore was antecolic in 33 per cent (92 cases) and retrocolic in 0 per cent (34 cases). One other feature common to all 3 cases with recurrence was a wide stoma. X-ray examination and fractional test meal studies showed that the stomach remnant emptied readily and rapidly. This does not support the view that rapid emptying gives greater protection against recurrent ulceration because of the more rapid neutralization of acid.

There are 3 possible causes for the not uncommon postcibal syndrome of disagreeable sensations on taking food: (1) the small size of the stomach stump; (2) reflux into the afferent jejunal loop; and (3) "dumping" into the jejunum. The author does not consider distention of a small stomach stump or reflux into the afferent loop to be the cause of these symptoms for a number of reasons. In this series

only a few patients stated that their meals were of necessity of smaller volume than normal although many restricted the volume of food in order to lessen the postcibal symptoms. "Dumping" is the commonly accepted cause of most of the unpleasant symptoms after gastrectomy and the author suggests, as do many others, that a reconstruction of the Hofmeister Finsterer valve type might help to do away with some of the jejunal dumping by narrowing the entrance to the jejunum. He believes further that rapid emptying of the stomach due to the size of the anastomosis is responsible for the vomiting of bile in some of these patients.

In the course of this study 71 fractional test meals were carried out. Mucus was present in all specimens in all cases. Bile was present in all specimens in most of the cases. All of the patients showed a lowered total acidity, which indicated an actual diminution in the quantity of gastric juice secreted. The cases in which the test meals were done were divisible into two main groups: 49 in which the ulcer, whether gastric or duodenal, was removed completely and 22 in which the modern modification of pyloric exclusion for duodenal ulcer was performed. The 49 test meals after routine gastrectomy confirmed the usual findings, i.e. most of the cases failed to show the presence of free acid and all showed a diminished total acidity. Only 7 cases showed free acid. In 2 of these the patients had an excellent clinical result, in 4 a good result, and in 1 there was some improvement. The figures show that the stomach remnant does not appear to behave differently whether the ulcer was gastric or duodenal, although duodenal ulcer is usually associated with a much higher acidity. The length of time after operation would appear to make no difference to the acid secreting capabilities of these postoperation stomachs. The 22 test meals after gastrectomy with pyloric exclusion and closure of the antral mucosa showed that 14 of the patients had free acid. If one believes that recurrence of ulceration is at least associated with the presence of free hydrochloric acid, then one might expect that the incidence of recurrence in this group would be higher. Fortunately this seems not to be so although most of the cases are of fairly recent operation date. The presence of free acid is rather alarming and suggests that until we know more about the exact role of free acid in peptic ulceration, pyloric exclusion should not become a routine operation. The higher incidence of free acid in these cases may be due to incomplete removal of mucosa from the pyloric antrum, or possibly because the whole of the first part of the duodenum is preserved and continues to manufacture gastrin.

Hypochromic anemia is definitely a complication of partial gastrectomy but does not occur frequently enough for the operation to be condemned on that account. It is more common after gastric ulcer and is almost always of the microcytic type. It is usually of mild degree but may become severe if not treated. In either case response to iron is excellent. Diet for prolonged periods may be a predisposing factor but

the anemia is not related to the presence or absence of free acid. The anemia is insidious and often causes no complaints, and females are more prone to it than males. A preoperative anemia is not unreversible and the clinical result does not depend upon the blood picture. The possibility of anemia in a patient after a Polys gastrectomy for gastric ulcer should be borne in mind since it seems to be a disadvantage of that operation.

JOHN L. LUNDQUIST M.D.

Aberrant Gastroduodenal Pancreatic Tissue (*Les pancréas aberrants gastro-duodénaux*) R. Joyeux, H. L. Guilbert and Guerrier *J. chir. Par.*, 1947 63 261

The discovery at operation of aberrant pancreatic tissue is not infrequent and such tissue should no longer be considered an anatomical curiosity. The authors present the case histories of 3 patients in whom accessory pancreatic tissue was found in 1 patient on the duodenal bulb and in the other two on the wall of the pyloric antrum. The symptomatology closely resembled that of an ulcer and it was with the probable diagnosis of duodenal ulcer in 2 cases and of pyloric ulcer with stenosis in the other case that the patients were operated upon. Subtotal gastrectomy was done in each of the 3 cases.

A review of the literature presents one series of 33 patients exhibiting aberrant pancreatic tissue all of whom had symptoms which led eventually to surgical intervention. These as well as previous reports bear out the fact that accessory pancreatic tissue occurs most frequently in the stomach duodenum and jejunum. The aberrant tissue was found in the wall of the pyloric antrum or the duodenal bulb in 26 of the 33 patients, near the duodenojejunal angle in 2 in Meckel's diverticulum in 2 and in the gall bladder the ampulla of Vater and the rectal mucosa in 2 patients each. It is because of the predominant localization in the pyloroduodenal area that symptoms requiring surgical intervention may occur.

Anatomically the accessory pancreas may be represented as a small plaque, a small tumor or more often by a simple thickening of the wall of the digestive tract which often may cause ulceration of the mucosa. In the usual case the tumor is small and is located either in the submucosa or the muscularis where it separates the muscular fibers. Some of the aberrant tissue may merely rest upon the gastroduodenal wall. Histologically, in the great majority of cases the tissue contains both exocrine and endocrine elements. However in many cases the cells of the islands of Langerhans and the ductile elements may not only be atrophic, but the site of acute or chronic inflammation or of cystic degeneration.

The aberrant pancreas is physiologically active tissue. Many reports in the world literature associate accessory pancreatic tissue with the presence of gastroduodenal ulcer but in the author's experience this was an uncommon couplet. The mucosa is usually intact and it may be mere coincidence that an ulcer is found in contact with an accessory gland.

The symptoms may be merely functional. Dyspepsia is a common complaint. Symptoms of gastroduodenal ulcer with or without pyloric stenosis are frequent. Two factors in the operative diagnosis are important (1) the pancreatic nodule has neither the consistency of a neoplasm nor of an ulcer and (2) the serosa does not have the cicatricial appearance of serosa in contact with an ulcer.

The accessory pancreatic tissue results from the faulty fusion of the buds which embryologically form the pancreas. Some workers are of the opinion that the occurrence is a throwback to the lower animals the cyclostomes in which the pancreas is included in the intestinal wall.

When symptoms indicate laparotomy and suspicious nodulations are found in the upper intestinal tract excision of the nodule and immediate frozen section examination will determine the diagnosis in the majority of cases. Simple excision of the lesion is adequate in most cases but partial gastroduodenectomy may be necessary when a large amount of accessory pancreatic tissue is complicated or associated with peptic ulcer.

ORVILLE F. GRIMES, M.D.

Schwannomas of the Stomach (*Sur les schwannomes de l'estomac*) Jean Gomez. *J. chir. Par.*, 1947 63 463

The frequency with which schwannomas of the stomach occur as reported in the world literature varies between 0.5 and 1.5 per cent of all gastric tumors. The schwannoma (more familiarly known in the American literature as neurilemmoma or perineural fibroblastoma) is the second most common benign gastric tumor the myoma being the most common.

Various opinions have been expressed concerning the origin of these tumors. It is the belief of some that they arise from the endoneurium and are therefore of mesodermal origin. Others have indicated that they arise from the cells of Schwann and hence from ectodermal anlage.

The favorite sites are the pylorus and the cardia. Clinical symptoms arise from the mechanical interference occasioned by the presence of the tumor. These forms are described (1) an interstitial form in which the tumor is entirely intramural ovoid usually small seldom ulcerated and well limited by a connective tissue capsule (2) the endogastric or pedunculated form which may become quite large and is usually ulcerated and (3) the extragastric form arising from the serosa which may attain a large size and may displace the stomach considerably by its pressure.

Of especial interest is the usual existence of submucosal nodules separate from the principal tumor but having an identical histological picture. The tumors are extremely pleomorphic frequently assuming fibrosarcomatous or myosarcomatous aspects. Pseudocarcinoma or colloidocystic degeneration is common and it is for these reasons that the malignancy or benignancy of these tumors is many times in doubt.

Gastric hemorrhage occasionally of sufficient severity to cause an anemic state is the most common clinical finding. Vague dyspepsia is common.

Röntgenologically by the use of contrast media, the pedicle of the tumor can many times be shown this will indicate a benign process in most cases. The mobility of the lesion is the important clinical factor in distinguishing the benign lesions from cancerous growths.

One can entertain a presumptive diagnosis of a benign gastric tumor by the discovery of an epigastric mass with the preservation of a state of well being, gastric hemorrhage without pain, the existence of a hemorrhagic state without cachexia, and the absence of periodicity of the pain. These clinical findings plus the roentgenological findings of a perfectly delimited tumor with regular contours and an ulceration in the mass, and a gastroscopic appearance similar to that of a diverticulum may permit one to make a presumptive diagnosis of schwannoma.

If untreated these tumors may cause distress by compression of the neighboring organs hemorrhage infection obstruction at the pylorus, perforation or by malignant degeneration.

The treatment should always be surgical. Local excision of the lesion with a generous margin of the base is employed many times. However the authors believe that subtotal gastrectomy by which no less than two-thirds of the stomach is removed is the method of choice in order to remove the aberrant nodules which are usually present. A limited excision may be employed for the extragastric type.

The author briefly presents the case histories of 4 patients in whom subtotal gastrectomy was performed to remove endogastric schwannomas. All have remained well. OVERTON F. GRIGGS, M.D.

Gastric Cancer Owen H. Wangersteen. *J Am M Ass* 1947 34 216

This extensive review of the problem of gastric cancer deals with the disease from the standpoint of etiology, diagnosis, and treatment. It is of especial interest, since it combines scientific data with philosophic thinking, and a delineation of the problems facing us at present and in the future.

The ultimate salvage of life following a diagnosis of gastric cancer is small. Though gastric cancer is curable the disease is rarely recognized in time for such a cure to be accomplished. Cancer of the stomach is the most frequent of all malignant growths.

From the standpoint of etiology there is a wide diversity of opinion concerning the origin of gastric cancer. Most authorities agree that gastric cancer probably does not originate *de novo* from a normal gastric mucous membrane. There is no unanimity of opinion, however, concerning the importance of items which it is believed may give special encouragement to the development of gastric cancer among these are to be enumerated (1) the benign polyp, (2) gastritis, and (3) gastric ulcer.

There is also a sharp difference of opinion in regard to the role of extrinsic factors in the origin of

gastric cancer in man. There are those who believe that the so-called constitutional susceptibility is important. Nettlehip included such extrinsic factors as diet, age, heredity, heat, alcohol, bacteria, viruses, allergy, and infections. A study carried out in the author's clinic indicated that approximately 30 per cent of families give a history of cancer suffered among their members, but there was no closer correlation than this.

Several well known surgeons who, in the estimation of their colleagues, were authorities on the clinical aspects of the disease and who essayed to instruct others in the early manifestations of gastric cancer recognized the signs of the disease in themselves too late to benefit by that therapeutic agent of which they themselves were masters. Among them are to be enumerated the names of Johannes von Mikulicz, W. J. Mayo, D. P. D. Wilkie, and Martin Kirschner. R. D. Carman, a well known roentgenologist who contributed a useful sign to the roentgenologic diagnosis of gastric cancer had a gastric cancer which was inoperable before he recognized the signs of the disease in himself.

In an attempt to find precursors of gastric cancer, an experiment was undertaken to scrutinize carefully all patients with demonstrated histamine achlorhydria in men over 55 and in women over 65 years of age. Among 464 patients who were achlorhydric to histamine, 15 patients with polyps were found—the most fruitful observations of the study. During the 15 month period that this study was under way only 3 undetected gastric carcinomas were uncovered. Only 1 of these, however, was early. This patient's lesion was missed by roentgen examination. At operation it was found that he not only had a gastric carcinoma but also a second primary lesion of the cecum.

The experience of this clinic suggests that radical operations for gastric cancer including total gastrectomy can be performed at a reasonable risk. For the past 4 years, during which time 160 resections (including total gastrectomies) were performed, the hospital mortality was 8.1 per cent. In 1945 there were 62 resections (including 9 total gastrectomies) with 3 deaths (4.8 per cent mortality). The resection rate of patients operated upon for gastric cancer in this clinic was approximately 90 per cent. This implies that palliative resections were undertaken in a number of instances.

Cancers *in situ* perhaps will not often be recognized in the stomach yet periodic examination of all men and women who have reached the cancer years undoubtedly will make an important contribution to the earlier recognition of cancer. One cannot await the complete evolution of the clinical symptoms.

The establishment of cancer detection clinics, staffed by specialists, affords the best promise of the early recognition of cancer. Women over 40 and men past 50 years of age should report regularly to such clinics. The solution of a difficult problem such as this demands the following: (1) members of the

medical profession must look at the problem realistically and learn to know all the facts bearing on it. (2) they must constantly enlarge their knowledge of the field by vigorous research and clinical investigation. (3) all available resources must be combined to lead pursuit of the inquiry the greatest promise of solution. (4) the solution of the problem must envisage an interest in the problem as it relates to the present generation as well as to those yet unborn. New discoveries as well as to those yet unborn. energetic research program constitute the hope of the future.

HAROLD LAURMAN, M.D.

A Statistical Study of 1,405 Cases of Cancer of the Stomach. W. L. Harnett. *Brit J Surg* 1947 34: 379.

This study is based on the statistical survey of 1,405 cases of primary carcinoma of the stomach published by the British Empire Cancer Campaign in 1934. The cases were followed up for 5 years with only 1 per cent of the patients being untraced.

There were 856 males (61.7 per cent of all male cases of cancer registered) and 549 females (69 per cent of all female cases). The region of the stomach postmortem findings. Fifty-four per cent of the carcinomas were in the pyloric region, 33 per cent in the cardia, 13 per cent in the pyloric region, and 13 per cent in the cardia.

The youngest patients were a female aged 30 and a male aged 31. The mean age of the 691 patients who were submitted to operation was 56.83 years.

The occupations of the male patients were arranged in order of frequency and compared with the percentage of males over 14 years in Greater London following the same occupations. The figures warranted the conclusion that those admitted were a fair sample of the general population and thus there was no connection between the occurrence of gastric carcinoma and any of the occupations.

Definite pain following eating was the first symptom in 74.7 per cent of all the patients. Sudden onset with the vomiting of blood occurred in 15 per cent of the entire group and in 35 per cent of those with growths in the cardiac region. In 66 per cent there were no symptoms directly related to the stomach and the diagnosis was established by surgery or autopsy. In 13 per cent, metastases to the bones, lungs or the lymph nodes preceded discovery of the primary tumor. Onset of the symptoms was stated to be gradual in 68.4 per cent and sudden in 31.6 per cent.

Fifty-four and one half per cent of all the patients consulted a doctor within the first 3 months and 10 per cent within the next 3 months. There was some delay on the part of the physicians to treat the patients. Sixteen per cent came to the hospital directly 37 per cent were referred to the hospital for investigation at once, and 13 per cent after an interval of less than 3 months. 19 per cent were treated symptomatically for more than 3 months and 1 per cent were not at all worried.

Seventeen and one-half per cent of the patients lost up to 28 pounds in weight and 19.4 per cent lost more than 28 pounds. Only 3.8 per cent lost no weight at all and the amount lost in the other cases is not known. There was a definite palpable tumor in 49 per cent of the patients and an indefinite mass in 9 per cent. Obstruction to the passage of food was diagnosed clinically in 33.6 per cent of the growths in the pyloric region, in 10 per cent of those in the mid gastric region and in 7 per cent of those in the cardia. Recognizable distant metastases were present in 35.5 per cent of all the patients on admission to the hospital. In 6.9 per cent the cervical or supraclavicular lymph nodes were affected, and in 5.4 per cent metastases could be palpated on rectal examination. Of 457 recognizable metastases, 85.3 per cent were in the liver or abdominal organs, 3.5 per cent were in the lungs and 3.6 per cent in the bones.

The 1,405 patients diagnosed as having gastric carcinoma were treated as follows: 687 had neither surgery nor radiotherapy, 33 were treated with radiotherapy, 243 had their stomachs resected, 215 had a palliative procedure, and 433 were explored only. The operative mortality for all radical operations averaged 39.9 per cent, ranging from 25.4 per cent for the Polya method of partial gastrectomy to 90 per cent for total gastrectomy. The 5 year survival rate for males for all radical operations was 19.8 per cent, and for females 27.1 per cent, not including the operative mortality. The 5 year survival rate for males for all methods of resection was 18.6 per cent and for females 19.8 per cent, not including the operative mortality.

There were 56 patients surviving after 5 years (4.03 per cent of all cases). Of these, 36 had been treated by partial gastrectomy, 7 by palliative operations, 2 by radiotherapy, 1 had exploration only and 10 had not been treated. The proper diagnosis of the latter 10 has since been questioned.

DANIEL RUCK, M.D.

Irradiation of Gastric Cancer. G. Cranston Fairchild and Alan Shorter. *Brit J Surg* 1947 34: 243.

Cancer of the stomach still remains a problem. It is responsible for 15,000 deaths annually in Great Britain, and for 40,000 in the United States, 33 per cent of all cancer deaths in America. It is the commonest type of cancer with the poorest results from treatment, for on the average, only from 1 to 4 per cent of all patients are alive after 5 years following curative surgery and only about 4 months following palliative surgery. At present some 80 per cent of patients with gastric cancer are beyond any hope of cure by surgery alone when first brought to the surgeon. But what if irradiation—so postmortem findings show that over 50 per cent of people dying of gastric cancer have the disease still confined to the stomach and immediately adjacent lymph glands. Because of the impossibility of a surgical cure in such a vast number of cases many other forms of treatment, including irradiation have been tried, but without striking success.

Different forms and combinations of irradiation applied to this vascus have their limitations and shortcomings. External irradiation fails because of the deep situation of the gastric tumour and its close relation to other vital organs—both factors tending to prevent adequate tumor dosage—and because of the high but variable radioresistance of gastric cancer cells, possibly increased by infection. Movements of the tumor make accurate centering of the x ray beam at repeated exposures difficult to obtain. Contact therapy with the Chaoul tube covers a relatively small area (2 cm. in diameter) in each field with very little penetration at low voltage. With the Chaoul tube, bulky tumors could not be destroyed by single surface doses at one operation, but needed repeated exposures. This could be done only through some kind of fistula or pouch formation. With such a small field as 2 cm., repeated applications would be required for most inoperable tumors, with the obvious difficulty of adequate and uniform dosage. Also such localized irradiation would have no appreciable effect on any glandular or other local spread the presence of which is the usual reason for inoperability. Radon seed implantation has the same difficulty of uniform and adequate dosage (as shown by subsequent radiography) when introduced at operation from either serous or mucous surface, or through a gastrostomy opening or the esophagoscope. There are also dangers of hemorrhage and infection and perhaps perforation due to massive necrosis of the tumor while the adjacent field of spread does not receive adequate irradiation.

Intracavity irradiation with the five way tube described by Livingston and Pack (1941) has, they claim, the advantages of easy application, fractionation of doses, avoidance of damage to adjacent vital organs, freedom from dangers of hemorrhage, infection, and perforation, and no interference with food intake, but they had not at that time determined how effective a total dose patients would stand, the most effective fractions into which to divide the total dose, or the results as regards palliation or cure. Used alone it would appear not to have much effect on local spread, but combined with direct irradiation it might perhaps be used to supplement the dose reaching the center of large gastric tumors. Many people think that irradiation not only shortens the patient's life but also adds to his sufferings, and therefore is quite unjustifiable. While this may be true of many of the other methods of treatment, direct irradiation at high intensity has none of these disadvantages.

Fairchild (1933) first conceived the idea of direct irradiation of deep-seated tumors exposed temporarily at operation. The following advantages of the method are noted.

1. More accurate information about the size, shape, position, and extent of the primary lesion and any local or general spread, can be obtained at the exploratory operation than can be found out by any other methods, either clinical or laboratory. In the thorax, where a fairly satisfactory radiological examination can usually be made the extent of a

cancer is almost invariably greater than it seems from x ray films. So, in the abdomen, the growth is nearly always more extensive than can be determined by the usual examinations and investigations. According to Walters et al. (1942) exploratory operation is the only reliable way of deciding the correct form of treatment.

2. Biopsy specimens can usually be obtained to help confirm the diagnosis. With palpable glandular involvement this can be done safely, but incision of the tumor may spread tumor cells or lead to perforation owing to subsequent massive irradiation. This biopsy may not be practicable in all cases, but desirable to see and feel the tumor should make the diagnosis more certain than when relying on external methods of examination alone.

3. A more accurate and effective dose of irradiation at high intensity can be given direct to the tumor and field of local spread without irradiating such a large volume of normal tissue including vital organs and skin, unavoidable when irradiating from the skin surface. This may be of great importance in an already anemic and cachectic patient.

4. More accurate centering of the x ray beam is possible under direct vision than when relying on x ray films or clinical examination alone.

5. The skin is left practically intact, and will permit further full dosage to be given externally at a later date should this be deemed necessary. Supplementary external irradiation was given later in some of the earlier cases, beginning about 10 days after operation as it was believed the initial dose was too small to cure. Some patients had further external irradiation after some months.

6. Various operations to relieve obstruction can be performed before the irradiation, at the same or an earlier and less extensive laparotomy such as gastrostomy for cardiac obstruction and gastrojejunostomy for pyloric lesions. Though the obstruction may not be severe it increases owing to fibrosis of the tumor after irradiation. In hopeless cases these operations can be done without irradiation to relieve symptoms.

Diagnosis and localization of the tumor are achieved as accurately as possible by clinical, radiological, gastroscopic, esophagoscopic, and laboratory investigations. The general condition of the patient is investigated as regards the possibility of metastases, state of nutrition, and fitness for anesthesia and operation.

Owing to the tendency of the growth to spread along the stomach, or to lymphatics above, behind, or below the stomach, the exposure must be such as to enable the direct irradiation to be carried out in an anteroposterior plane otherwise uniform irradiation of the tumor area would not be possible. It follows that the left transthoracic approach is unsuitable for direct irradiation even for the cardiac area and lower esophagus. This may be in one or two stages (Fairchild and Shorter 1945).

1. When there is well marked cardiac or pyloric obstruction gastrostomy gastrojejunostomy or even

Jejunostomy may be necessary before the patient's condition can be improved sufficiently to stand the wider exposure and irradiation. This is usually done through a small upper left paramedian incision making exploration of the tumor and the whole abdomen possible. Many cases have in this way been found unsuitable for irradiation owing to unsuspected wide spread metastases.

2 When the patient's condition seems satisfactory the abdomen is explored through a different incision more suitable for extension, even into the thorax if necessary. This practice has been followed when the condition of the patient will allow it so as to avoid the two operations advocated by Garlock. Also it saves moving the patient in making separate incisions for the exploration and the main exposure. The form of treatment and the main exposure in decided upon beforehand to be carried out complete in abdomen must be thoroughly explored before making an extensive exposure especially before opening the thorax. It would seem to be unwise and unfair to the patient to open his thorax and divide his diaphragm before estimating carefully the extent of spread in the abdomen.

When operations to relieve obstruction are necessary they are done before the irradiation is commenced. Irradiation of the stomach and when the field is avoided by displacement and packing out protect the skin edges of the wound. More recently a special sterilized applicator was used to avoid infection during irradiation but allows accurate visualization of the tumor in the x-ray beam. To avoid shock produced by frequent moving a special trolley has been designed on which the patient can have both the operation and the irradiation.

Fifteen patients were treated by direct irradiation. These cases can be divided into two groups. In the first group were 7 cases in which the irradiation was purely palliative owing to obvious spread beyond the possible field of irradiation, or to a poor general condition. Of these, 2 patients are alive and well after 5 weeks. 1 lived 6 months. 1 lived 5 months and 2 lived 4 months. The rest died sooner. In the second group of 8 cases the growth appeared to be limited to an area that could be irradiated. Of these, 2 patients lived 24 months and 1 lived 3 months after treatment. The remaining 2 patients died within the first week—one from bilateral pulmonary collapse while the wound was being closed, the other from spontaneous pneumothorax on the opposite side 4 days after operation.

Although the series is small, direct irradiation with high intensity will prove to be a rational and hopeful advance in the treatment of cancer of the stomach and other viscera. Whether the cancer is rendered inoperable by the poor general condition of the patient or by irretrievable local spread this method will

often succeed where surgery alone must inevitably fail. Though wider exposure is needed than for surgery alone, with adequate precautions the whole procedure should not be so shock-producing as is wide surgical excision.

Exploratory operation is the only reliable way of deciding the correct form of treatment, and the hospital of the future will have a radiotherapy room adjoining the operation theater to facilitate direct irradiation.

Performed Sigmoiditis (Sigmoiditis perforata) Adol
fo Duforich and S Form. *Brazil med cir* 1946
8 237

The authors present the case of a patient with perforated sigmoiditis who was operated on 6 hours after the perforation. In this case it was not possible to identify the etiologic agent although other authors found the majority of cases to be the causative factor in

A relatively large ulceration of the mucosa and submucosa was encountered with an abundant infiltration of leukocytes as well as an increased number of histiocytes and of other elements not well identified. The symptomatology was similar to that of an acute perforated appendicitis. Pain, usually in the left lower hypogastric area was sudden in onset and unbearable. The patient was in a cold perspiration and a prodromal ulcer and it produced a certain amount of shock. The patient was in a cold perspiration and fainted at the height of the paroxysm. At the onset of the peritonitis the pulse and temperature were parallel. Tenderness was elicited on the side of the perforation associated with muscular rigidity which was more prevalent on the left side. Abdominal distention came later. Vomiting was not early or frequent although nausea was present from the start.

This condition must be differentiated from the acute appendicitis perforated gastric and duodenal ulcers. The prognosis depends on early surgical intervention, virulence of the micro-organisms and the lesions of the peritoneum to form protective adhesions. The author's policy was discharged in 72 days after admittance.

The treatment was simply surgical and consisted of suture of the defect in 3 planes and covering of the site of perforation with epiploicæ. Sula therapy with drainage of the peritoneal cavity is of unquestionable value.

A Case of Multiple Hyperplastic Tuberculosis of the Colon. *Harald Brodin Acta radiol., Stockh.* 1947 28 237

Hyperplastic tuberculosis of the intestine is as a rule a solitary tumor most often located at the ileocecal valve. It is an uncommon condition. In the literature one series of 72 cecal tumors is reported, 9 of which were tuberculous and of the only 5 were of the hyperplastic form. Another report of 8 cecal autopsies showed 233 cases of intestinal tuberculosis of which 2 were of the hyperplastic

type. Cases in which multiple hyperplastic tuberculous lesions of the intestinal tract are present are rare.

In patients suffering from this disease other foci of tuberculosis are uncommon. Some authors believe this form of tuberculous infection is a primary type of infection. The mode of infection is thought to be via the blood stream, although it may originate by lymphatic spread from tuberculous mesenteric glands.

The symptoms of hyperplastic tuberculous infection of the colon are usually of long duration and consist of colicky pain, loss of weight, nausea and anorexia. Diarrhea, constipation, or alternating periods of each may be present. Examination usually reveals a palpable abdominal tumor, anemia, slight rise in temperature and a raised sedimentation rate. Fistulas may be present. The diagnosis is difficult, and the differentiation from cancer may be impossible. Multiple cancer of the colon is more common than multiple hyperplastic tubercular tumors. A case of multiple hyperplastic tubercular tumors of the colon is presented.

F J LEREMARK, JR. M.D.

The Management of Cancer of the Colon. Paul L. Hoxworth and James Mithoefer. *Surgery* 947 ss 572

The present differences of opinion among surgeons with respect to operative procedures for cancer of the colon lie largely in the technique of resection and re-establishment of continuity of the bowel after resection. Two schools of thought exist—one chooses a method requiring delayed anastomosis and the other prefers to restore continuity of the intestine immediately. Much progress has been made along both lines of approach since cure of cancer of the colon was first undertaken. At the authors' clinic the plan of choice has been that of anastomosis at the time of resection by either an open or closed method. For the success of this procedure it is necessary to establish suitable conditions for the relief of obstruction for the avoidance of sepsis and for primary healing by use of careful preoperative, operative and post-operative measures. If these conditions cannot be met in each individual case it is safer to resort to exteriorization and delayed anastomosis. Under this plan 87 resections for cancer of the colon were performed in the 9 year period from 1938 to 1946. The management is presented in some detail and the operative results are reported.

Emphasis is placed upon the following fundamental principles:

In the preparation of the patient for resection relief of obstruction and thorough cleansing of the intestine should be achieved along with preliminary correction of anemia and of disturbances in electrolyte nutrition and hydration. Operative principles include the use of the transverse abdominal incision, careful attention during resection of the mesentery or preservation of the blood supply to the segments of bowel at and adjacent to the proposed site of anas-

tomosis, gentleness in the dissection and handling of the bowel and its mesentery, adequate mobilization of the segments to be anastomosed in order to prevent tension at the line of suture, precision in the placing of sutures after careful preparation of the bowel to receive them, the use of inverting mattress sutures which catch the submucosa but do not penetrate the mucosa and are tied tightly enough to hold serosal surfaces in apposition without strangulation of the tissue, avoidance of inverting too much of a diaphragm, accuracy in approximating the edges of the mesentery and in re-peritonealizing denuded areas, isolation of the field of resection and exclusion of contaminated gauze, instruments, towels, and gloves from the field before re-peritonealization and closure of the wound.

Further principles include the use of continuous gastric aspiration until obstruction is relieved, and, during the immediate preoperative and postoperative period, the provision of adequate hydration and nutrition, the prevention of atelectasis after operation and parenteral administration of sulfadiazine and penicillin if soiling has occurred or at the onset of signs of sepsis.

The 87 cases represent an operability rate of 60.4 per cent among a total of 144 cases. Of the 87 resections performed, 16 were classed as palliative. In lesions of the right colon ileotransverse colostomy was carried out as the first procedure in 13 cases, 10 of which it was only palliative and was not followed by resection. Only 3 of the 24 patients with cancer of the right colon who had resection showed obstruction, whereas about half of those with tumors of the transverse and left colon had complete or partial obstruction at the time of admission to the hospital. In all of these cecostomy or transverse colostomy was done as a preliminary step to relieve obstruction. In 6 of 63 cases in which resection was done for lesions beyond the hepatic flexure circumstances encountered at the time of resection prevented the operator from proceeding with end-to-end anastomosis.

Among the 87 cases of resection there were 6 deaths, a mortality rate of 6.9 per cent. Four deaths were due to leakage at the site of the anastomosis which resulted in peritonitis. All of these cancers were in the left colon. One patient died of pneumonia and 1 of uremia. The average hospital period for the 79 surviving patients treated by resection and immediate anastomosis was 36 days from the time of resection to time of discharge from the hospital. In patients in whom a cecostomy was performed the average interval between the cecostomy and resection was 15 days.

JOHN L. LUNDQUIST M.D.

The Management of Carcinoma in the Several Parts of the Colon. William F. MacFee. *Ann. Surg.* 1947 125:1-5.

The author describes the historical development of the modern techniques used in surgical therapy of carcinoma of the colon. He cites the perfection of an aseptic method of resection and anastomosis, pro-

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imal decompression in the presence of the obstructed use of intestinal antiseptics, earlier diagnosis and greater appreciation of the importance of fluid and proteio balance, and the use of vitamins and blood transfusion as factors in lowering the mortality resulting from the surgical treatment of carcinoma of the colon.

The various proponents of the exteriorizing stage resections and those advising primary resection with end-to-end anastomosis are named. The author states that the present trend is in favor of resection with end-to-end anastomosis and justifies this by stating the fact that in the numerous series of case reports, the mortality of primary resection with anastomosis is half that of exteriorization with stage resection.

Reichel's basic principles for closed resection with anastomosis are reiterated: (1) the general condition of the patient must be adequate for a long operation; (2) the proximal bowel must be decompressed; (3) the intestine must be viable and free of circulatory disturbance, and there must be no tension on the sutured lines of the anastomosis. In the absence of obstruction fixation or infection a carcinoma in almost any part of the colon may be resected and continuity restored immediately without undue risk.

Uncomplicated carcinoma of the cecum ascending colon and hepatic flexure may be resected and ileo-transverse colostomy performed at a single operation. In the presence of obstruction fixation or infection ileo-transverse colostomy should be done first with resection following later.

Carcinoma of the transverse colon ordinarily may be resected and anastomosis established as a one stage operation. Obstruction extensive fixation or infection calls for preliminary colostomy or coloproctostomy. Carcinoma of the splenic flexure is often recognized late, complications are frequent and surgical approach may be difficult. Preliminary colostomy or transverse colostomy should be the rule with primary one stage resection reserved for the exceptional case. Transverse or subcostal incision provides a good exposure.

In the descending and sigmoid colon primary resection and immediate anastomosis are permissible provided there are no complications. Obstruction by colostomy or gross infection requires proximal drainage the latter. Diverticulosis may confuse the diagnosis.

At the rectosigmoid level preliminary transverse colostomy with complete diversion of the feces is a prerequisite for resection with immediate anastomosis. Faulty healing of the suture line frequently results in leakage infection and fistulas. The presence of feces in such a field is a serious disadvantage drained through the pelvic peritoneal floor should be freely drained through the coccygeal bed. Primary one stage resection and anastomosis may succeed in any part of the colon proper but it should not be performed for tumors in the rectosigmoid and its use

elsewhere should be restricted to uncomplicated lesions.
 EMMETT D. BLOOM, M.D.
 LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Traumatic Rupture of the Liver without Penetrating Wounds: A Study of 32 Cases. Louis T. Wright, Aaron Prigot and Lyndon M. Hill, Jr. Arch. Surg. 1947 54: 613

This article is a report of 32 cases of traumatic rupture of the liver without penetrating wounds studied at the Harlem Hospital between 1935 and 1946.

Of some 20,000 patients admitted to the Traumatic Service 18 had subcutaneous rupture of the liver an incidence of 1 to 1,121. In the present series there were 27 cases among 34,000 admissions an incidence of 1 to 1,259. These figures tend to show that this condition is not as infrequent as the reports to the literature would lead one to believe.

The liver and spleen together make up 75 per cent of all intra-abdominal injuries of solid viscera, with a somewhat greater frequency of solid viscera, with being struck by an automobile and falling are the more common causes of liver injuries occurred in males and 11 in females. The friability and position of the liver combine to render it vulnerable to direct injury and injury by contrecoup. The larger less protected right lobe is more easily injured. It was injured in 27 cases the left lobe was injured in 2 and both lobes were injured in 3 cases.

The liver when injured tends to split and crack in stellate fashion with hemorrhage and escape of bile. The dome of the liver was most susceptible which tended to disprove the idea that most ruptures occur along the posterior inferior surface where the liver is thrown against the vertebral column.

In all cases there were moderate (from 200 to 500 c.c.) or larger amounts of blood in the peritoneal cavity. The reasons for this copious hemorrhage are that (1) thin walled hepatic veins have no valves and do not retract or contract (2) blood mixed with bile does not clot readily (3) diaphragmatic movements aggravate the injury and (4) the friable hepatic tissue does not act as a tampon.

More trauma is necessary to rupture the liver than the spleen. In only 10 cases were there no associated lacerations of the brain and spinal cord ruptured spleen and fractures.

In classifying traumatic rupture of the liver the authors favor a classification dependent on the rate of hemorrhage. This rate may not be in proportion to the amount of damage to the liver. In a series of 21 cases reported by Vance one third of the patients died at the site of the injury, 38 per cent died within 6 hours, and 28 per cent lived long enough for clinical study.

The authors 4 clinical types are (1) massive hemorrhage causing almost immediate or sudden

death (2) acute hemorrhage producing shortly after injury a state of shock which rapidly becomes deeper (3) repeated small hemorrhages, and (4) spontaneous cure. Case histories illustrating each type are given. The greatest number of cases fall in the second and third groups.

The diagnosis of rupture of the liver is difficult even without complications. Symptoms may not develop for 6 hours or more. The signs are hemorrhage, shock, and peritoneal and diaphragmatic irritation. Rarely a tender mass may be palpable or blood appears in the vomitus.

Severe abdominal pain made worse with respiration is the most common complaint. Pain radiating to the right or left shoulder (Kehr's sign) is helpful if present, but frequently it is absent. Vomiting occurs not infrequently as a reaction to the trauma. Symptoms of internal concealed hemorrhage are present.

These cases usually show signs of shock. Bradycardia is not observed. The point of maximum tenderness is apt to be misleading in localizing the lesion. Rigidity and rebound tenderness may be present. A palpable abdominal mass is helpful when present. Jaundice is rare but may appear in from 48 to 72 hours after injury.

Repeated blood counts and hematocrit determinations are necessary until the diagnosis of intra-abdominal injury is established. If blood is found in the urine, it is wise to rule out other causes of concealed hemorrhage.

X-rays may show a high diaphragm on the right in rupture of the liver. Abdominal tap and peritoneoscopy are invaluable aids in diagnosis of rupture of the abdominal viscera. The abdominal tap performed in all 4 quadrants should always be used in any suspected case. It was used in 15 cases and failed to disclose blood in 3. The finding of blood is indicative of intra-abdominal injury, whereas failure to find it does not rule out intra-abdominal injury. No "false positive" results were obtained. Peritoneoscopy was used once with a positive result.

Nonurgical conditions, such as contusion of the abdominal wall or fracture of ribs with shock due to hemorrhage into cavities other than the peritoneum, must be excluded.

The treatment of this emergency is surgical and delay increases the operative risk. Conservative treatment has a mortality between 75 and 95 per cent. Preoperatively shock must be combated with blood and plasma. Preoperative enemas and spinal anesthesia are to be avoided. The authors do not use autotransfusion because the blood may be mixed with bile and it may contain toxic products from autolysis of liver tissue.

All cases of suspected liver injury should be explored as bile may be spilled into the abdomen and lead to bile peritonitis, necrotic pieces of liver tissue may be present, or hemorrhage may be uncontrolled. This exploration should be carried out as soon as the diagnosis is made, and supporting measures can be carried out simultaneously. Early operation tends to

eliminate complications such as infection and fatty and hepatic tissue embolism.

Bleeding may be controlled by steam cautery, compression clamps, large sutures with bone plates or omental and fascial strips, digital compression of the hepatic artery or suture of the liver to the abdominal wall. Various types of gauze packs or muscle, omentum, fat, or rubber dams have been used. Simple tears can safely be sutured. Recent work with gelatin sponge indicates that it may be the best method of repair as it reduces operating time, loss of blood, and mortality rates.

The prognosis for rupture of the liver depends on the severity of the rupture but also on the severity of the associated lesions. Only 6 of the 32 patients in this series lived—a mortality of 81.3 per cent. Of the 26 who died, 11 died within 4 hours without surgical intervention. Of the 15 operated on, 9 died—an operative mortality of 60 per cent. Of the 6 who lived there were only 2 with associated injuries. In all cases the rupture of the liver was packed with gauze. The only complications were purulent discharge from around the packing and a decubitus ulcer in 1 case. No instances of hepatorenal syndrome or liver death were encountered. In the recovered patients the morbidity varied from 16 to 98 days. The gauze packing was removed between the fourteenth and fortieth days.

ROBERT R. BROOKS, M.D.

Congenital Absence of the Gall Bladder. Earl O. Latimer, F. L. Mendes, Jr. and W. J. Hight. *Ann. Surg.* 1947, 25, 39.

Three cases of congenital absence of the gall bladder discovered at operation are presented. In 2 of these cases a cholangiogram made postoperatively by means of a T-tube, showed the common duct to be patent but revealed no evidence of structures resembling either the cystic duct or the gall bladder. Oral cholecystography also failed to show evidence of an intrahepatic gall bladder. An analysis of 71 cases of congenital absence of the gall bladder approximately half of which were found at operation and half at autopsy is tabulated with respect to age and sex, symptoms, preoperative diagnosis, and attempts to prove the presence of an intrahepatic gall bladder. Syphilis, catarrhal inflammation of the biliary tract, fetal peritonitis, maternal toxins, and mechanical factors have been advanced by various authors as the causes of this anomaly. A more easily defended theory involves the embryology of the biliary tree.

There is no group of symptoms or signs which is of value in making the diagnosis preoperatively. When cholecystography fails to produce any shadow whatsoever, congenital absence of the gall bladder is not suspected because of its rarity. There is no reported case in which the diagnosis was made before operation or autopsy. Should surgical procedure fail to reveal the gall bladder in or about its normal location, the presence of an intrahepatic gall bladder should be ruled out preferably by retrograde cholangiography.

JOHN L. LUNDQUIST, M.D.

The Diagnosis of Pancreatic Disease by Enzyme Tests Lester M. Morrison *J Lab Clin M., 1947 32 1107*

The clinician has long found the diagnosis and treatment of diseases of the pancreas to be most difficult and uncertain.

The 20 patients with organic disease listed included 3 patients with carcinoma of the pancreas, 2 with pancreatic cirrhosis, 3 with cirrhosis of the liver, 3 with duodenal ulcer and 1 each with gastric ulcer, infectious hepatitis and cholangitis, carcinoma of the pyloric end of the stomach, carcinoma of the gall bladder and bile ducts and nontropical sprue respectively.

The respective average readings in the normal controls and the "functional" cases appear to be clearly defined. However the difference between the average readings of the "functional" and those of the "organic" diseases seems small. This lack of contrast appears to be due to the inclusion of a group of cases under organic causes in which the pancreas itself was not primarily involved. Cases of gastric and duodenal ulcer or cholelithiasis are examples. On the other hand, when the cases in which the pancreas is involved primarily, such as by carcinoma or cirrhosis or by stone, are examined, the test readings are consistently zero or very close to zero.

Percentages were not calculated since the range of variation in normal subjects, patients with organic disease of the upper digestive tract and patients with functional diseases of the upper digestive tract were so great that only repeated zero or near zero readings were of diagnostic significance.

Over 1,000 pancreatic enzyme tests were made of the duodenal secretions in a group of normal subjects, in a group of patients with "functional" or nonorganic disease of the upper digestive tract and in a group of patients with organic disease of the pancreas, biliary tract, stomach, or duodenum.

The range and mean of duodenal pancreatic enzyme tests for normal subjects and patients suffering from upper digestive tract disorders are described. Variations of test findings are very wide in both normal subjects and patients with most organic diseases of the pancreas or upper digestive tract.

Normal subjects as well as patients with extensive and severe pathologic involvement of the pancreas such as cancer may give zero or near zero test readings in individual duodenal pancreatic enzyme tests.

In patients with organic disease of the stomach or biliary tract, pancreatic duodenal enzyme tests revealed no individual distinctive or diagnostic findings. However, their group mean value was definitely lower than the comparable value in normal subjects.

A group of 10 patients with chronic low grade or moderate inflammation of the pancreas, as revealed at operation, underwent a series of duodenal pancreatic enzyme tests performed before and after operation. The duodenal enzyme study failed to show any consistently abnormal findings of diagnostic value either preoperatively or postoperatively.

In 6 cases of extensive involvement of the pancreas by cancer or cirrhosis with pancreatic lithiasis, 125 tests gave abnormal findings in the duodenal pancreatic enzyme tests. These abnormal findings showed either zero or near zero values.

If a zero reading was found in the pancreatic enzyme tests of a normal subject, it was not consistently found at subsequent determinations. In the presence of advanced and extensive pancreatic disease such as cancer or cirrhosis, zero and near zero readings were found consistently at all subsequent determinations.

Extensive and advanced disease of the pancreas such as cancer or cirrhosis with lithiasis gave repeated zero or near zero readings in the duodenal pancreatic enzyme tests. Pancreatic enzyme tests are useful in diagnosing advanced and extensive disease of the pancreas. HARRY W. FINE, MD

On Subcutaneous Injuries of the Pancreas V. Taitainen. *Ann Chir Gyn Fenn 1947 36 62*

Because of the anatomic location of the pancreas, traumatic injuries of this organ are rare. Only about 100 cases were collected from the literature by one author in 1941. In a series of 9,500 autopsies in Finland, pancreatic injury was noted twice.

The symptoms of injury to the pancreas are not typical and depend on the nature of the injury. If there is serious damage involving the blood vessels and pancreatic ducts, immediate pain and increasing signs of peritoneal irritation necessitating prompt operation are present. Generally, blood and pancreatic discharge enter the omental bursa which results in violent symptoms of shock. The foramen of Winslow usually closes but it may remain open and allow contamination of the general abdominal cavity to occur. Frequently there is a delay of some 3 hours between the time of the accident and the development of symptoms, and, although a similar symptom-free interval occurs with rupture of other abdominal organs, some workers have considered this symptom-free period to be pathognomonic of pancreatic damage.

A fairly frequent complication of pancreatic rupture is the subsequent development of a pseudocyst; perhaps one fourth of all pancreatic cysts are of this type. Such pseudocysts usually arise in the lesser omental sac, and are developed in a few weeks or months following the accident. The cyst wall is made up of a thin connective tissue capsule; there are no epithelial elements such as are present in a true pancreatic cyst. The symptoms of a pseudocyst are due to pressure on the adjacent structures such as the stomach (causing nausea and vomiting), the portal vein or vena cava (leading to ascites) or the celiac plexus (causing pain in the upper abdomen and left shoulder).

The diagnosis of pancreatic rupture is exceedingly difficult even with operative intervention because the rupture may involve the posterior surface of the gland and no fat necrosis may be evident. An increase in the serum or urinary lipase and diastase

values may be of considerable value during the first few days even in slight injuries.

Treatment of the injury varies with different surgeons from simple suture of the capsule to tamponade and drainage exteriorly. Pseudocysts are easily broken, and therefore, are most easily treated by marsupialization, although drainage into an adjacent organ (preferably the duodenum) has been performed.

The author reports a case of pancreatic injury in a previously healthy 12 year old girl who sustained a violent blow to the epigastrium from a bicycle handlebar. Exploratory laparotomy undertaken 3 days later revealed only a yellowish brown peritoneal exudate. Two months later a pseudocyst developed, and following marsupialization an uneventful recovery ensued.

WAYNE CAMERON, M.D.

MISCELLANEOUS

"Unexplained" Infarct or Intestinal Apoplexy
Comments on 2 Cases (Infarto "explicado" o apoplejia intestinal. Comentario sobre 2 observaciones) Alfredo Pierini. *Bolet Acad argentin cir* 1947 31 3 3

Two distinct types of mesenteric infarcts may be distinguished

1 The functional type possibly of an allergic origin which may subside spontaneously or under the influence of a treatment which combats the shock. This type may lead to vascular thrombosis and a resulting gangrene of the intestines. Adrenaline, on account of its vasopressor effect, has a beneficial effect on the condition.

2 The type caused by mesenteric endarteritis or thromboangitis. Ischemia is attributable to vasoconstriction and therefore an injection of adrenaline is contraindicated. Injection of novocain at the level of the superior mesenteric artery or spinal anesthesia, in addition to its therapeutic effect, may serve as a test valuable for the differential diagnosis between both types of infarct.

Anaphylactic shock provoked in animals may produce lesions similar to the functional or "unexplained" infarct in man. Allergens responsible for the condition in man may be of alimentary or bacterial origin. The resulting irritation of the sympathetic system in the splanchnic area leads to a functional infarct.

The author reports 2 cases in which a functional type of infarct produced an acute condition of the abdomen. In the first patient, a man 37 years of age, gastrectomy which was performed because of a gastric ulcer with resulting hypochlorhydria, and hepatic insufficiency caused by cholelithiasis, facilitated absorption of some ingested allergen. The operation disclosed a serosanguineous exudate in the peritoneal cavity, cyanosis and dilatation of the small intestines beginning approximately 1 meter below the duodenojejunal junction, and edema of the corresponding portion of the mesentery with dilated veins and also a dilated superior mesenteric artery. An intravenous injection of 1 mgm. of adrenaline was followed by peristalsis of the intestines (previously immobile) and reappearance of the normal color. The patient made an uneventful recovery.

The second patient, a man 50 years of age, also presented an acute condition of the abdomen. The operation disclosed subperitoneal edema, abundant serosanguineous fluid in the abdominal cavity, purple discoloration of 2 meters length of the small intestines, a hematoma in the corresponding portion of the mesentery and a dilated superior mesenteric artery. Intramuscular injections of 1 mgm. of adrenaline were followed by peristalsis and normal color of the intestines. The patient recovered from the operation.

JOSEPH K. NARAT, M.D.

The Effect of Radiation Therapy on the Nocturnal Gastric Secretion in Patients with Duodenal Ulcer. A correction. Erwin Levin, Anna Rasmann, and Walter Lincoln Palmer. *Gastroenterology* 1947 8 365

The third paragraph of this abstract which appeared on page 554 of the December 1947 issue reading "Treatment consisted of the daily application of 1,350 to 1,710 roentgens to the body and fundus of the stomach through two portals located anteriorly and posteriorly and was carried out for a period of 10 to 14 days" is not correct. The authors own words are as follows: All patients received a depth dose of 1,350 to 1,710 to the stomach in daily treatments through a period of 10 to 14 days. This was obtained by giving individual doses of 300 as measured on the skin with backscatter through two portals measuring 23 by 23 centimeters located over the body and fundus of the stomach, anteriorly and posteriorly."

GYNECOLOGY

UTERUS

Is Extensive Mutilating Surgery of Cancer of the Uterus Justified in the Light of Modern Knowledge? (Alla luce delle moderne conoscenze, nella terapia del cancro dell'utero, hanno ancora ragione di sussistere le tecniche chirurgiche ampiamente demolitrici?) Aldo Guasso. *Riv. ostet. ginec.*, 1947, 2, 107

Of 213 epitheliomas of the uterus 13 (15 per cent) were located in the corpus and 180 (85 per cent) in the cervix. Of the 33 cases of cancer of the corpus, 7 (30 per cent) were operable and of the 180 cases of cancer of the cervix 50 (13 per cent) were operable. Invasion of the lymphatics occurs only as an exception during the first 2 or 3 months of the existence of a malignant lesion.

Cancer of the cervix invades first the so-called interureterovaginal triangle. The author maintains that surgical intervention is useless and illogical if the cancer has invaded tissues beyond this triangle.

Radium introduced into the vagina and uterus is not capable of producing a cure as a rule but may be advantageously employed prior to the operation as roentgen therapy and so-called pleurotomy. The method also fails to produce a radical cure. Best results may be expected from applications of radium to the vagina and uterus followed by a hysterectomy and supplemented by deep x-ray therapy.

The terms radium surgery and roentgen surgery are applied to a concurrent use of surgery and irradiation. Theoretical considerations induced the author to prefer radium surgery to roentgen surgery although the method is not harmless.

The author came to the conclusion that cancer of the uterus is a curable disease and that the chances of cure are in direct proportion to the earliness of treatment.

JOSEPH K. NARAYAN, M.D.

A Discussion of the Preference for Total Abdominal Hysterectomy Instead of Subtotal Hysterectomy (Sulla discussione preferenza da darsi all'isterectomia totale addominale in confronto all'isterectomia subtotale) E. Debbiasi. *Fal. ginec.* Genova, 1947, 43, 233

A comparison is made between total abdominal hysterectomy and subtotal hysterectomy with regard to the morbidity mortality and complications of both. In the author's personal series of 185 hysterectomies for benign lesions he had a mortality rate of 1.1 per cent.

Factors in favor of total hysterectomy are as follows: (1) it is a radical procedure (2) the mortality rate is relatively low (3) the danger of cancer is eliminated (4) morbid changes in the stump are eliminated (5) there is relative infrequency of postoperative pelvic infiltrations, (6) there is a low frequency of postoperative disturbance of the intestinal function.

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tion, such as meteorism and (7) it has a minor effect on the pulse.

Factors in favor of subtotal hysterectomy are that (1) it requires less time (2) the mortality is less than that of total abdominal hysterectomy (3) the normal shape of the vaginal wall is maintained, (4) the technique is easier especially when the pelvic floor is rigid (5) there is slightly less postoperative disturbance of the digestive tract and (6) there is less frequency of wound separation.

Both procedures are favorable with regard to temperature respiratory disturbances period of bed confinement, the possibility of preservation of the adjoining organs and the possibility of secondary intervention.

The author advocates complete hysterectomy as a standard procedure and believes that the subtotal procedure is indicated only in the presence of special considerations such as a desire to maintain the menstrual flow technical difficulties, and the necessity to shorten the procedure in view of a grave condition of the patient.

ANTONIO F. CRONZA, M.D.

ADNEXAL AND PERUTERINE CONDITIONS

A Classification of Ovarian Tumors Based upon Histogenesis. John A. Spencer and Philip J. Reel. *Am. J. Obst.* 1947, 54, 273.

The study of ovarian tumors has received a tremendous impetus of late years because of the careful study investigation, and reporting of a goodly number of the more unusual neoplasms and the attempt to work out a truly scientific classification on a histogenetic basis. The anatomicopathologic type of classification has been utilized by most pathologists to date. Histogenesis should shed additional light on these tumors when they are viewed from the broader clinical standpoint, particularly in regard to treatment and prognosis. From the radiologic viewpoint, a more universal classification based on the histogenetic background literature would clear up the very confused literature which exists.

It is still necessary to use descriptive terms to name different neoplasms properly but it is no longer practical merely to classify these growths into the cystic and solid and benign and malignant. In the absence of a universally accepted histogenetic classification, the authors present a modification of the one suggested by Schiller.

Ovarian neoplasms are divided into three broad classes

1. Ovario-genetic tumors derived from ovarian tissue
2. Nonovario-genetic tumors derived from ovarian foreign to the ovary but found elsewhere
3. Carcinomas of undeterminable histogenesis.

Following this basic structure and filling in the subdivisions led to the following classification

1. Ovario-genetic (tumors developing from tissues of true ovarian structure)

A. From the mesenchymal core of the ovary

- (1) From fetal cell remnants without error in sex chromosomes
 - (a) Granulosa cell tumor
 - (b) Theca cell tumor
- (2) From fetal cell remnants with error in sex chromosomes
 - (a) Arrhenoblastoma—male
 - (b) Disgerminoma—neuter
- (3) From interstitial tissues without sex potential
 - (a) Fibroma
 - (b) Angioma
 - (c) Myoma and fibromyoma

B. From the surface epithelium of the ovary (proliferation toward the müllerian duct)

- (1) Serous cystoma (tube)
- (2) Endometrioma (endometrium)
- (3) Pseudomucinous cystoma (cervix)

2. Nonovario-genetic (tumors developing from tissues not normally present in the ovary)

A. By displacement into the ovary in fetal life

- (1) Early—teratoma
 - (a) Mature—dermoid
 - (b) Immature—embryoma
- (2) Late—tissue from structures contiguous to the ovary during embryological development
 - (a) Hypernephroma—adrenal
 - (b) Mesonephroma—kidney
 - (c) Brenner tumor—urogenital epithelium
 - (d) Ganglioneuroma—sympathetic ganglia

B. By displacement into the ovary in adult life

- (1) Metastases of malignant tumors—Krukenberg

3. Carcinoma of undeterminable histogenesis

A. Carcinoma simplex, scirrhous carcinoma, pleomorphic carcinoma

A discussion of the histogenesis of each tumor is presented. The value of this concept lies in its aid toward the diagnosis, treatment, and prognosis of ovarian tumors. JOHN R. WOOD, M.D.

EXTERNAL GENITALIA

Microbial Pictures in Vaginal Smears. New Classification of Vaginal Biocenosis into 6 Basic Types. (Mikrobiel obrazovani. Nová třídění poševní biocenózy na šest základních obrazů.) O Jirovec, R. Peter and J. Málek. *Čas. p. sm.*, 1947 1: 1

More bacteriological classification of the cleanliness of the vagina into grades does not satisfy clinical needs, for it omits the gonococci, protozoa (*Trichomonas vaginalis*) and phytococci (mycoparasites, yeast micro-organisms).

With regard to the entire microfauna, microflora, and the histological elements, the authors classify the vaginal biocenosis from the broader microbiological

point into 6 basic groups, which they call anatomic vaginal smears and they number them with Roman figures (I VI).

The basic microbiologic vaginal smears and their types are:

I. The normal physiological smear from the vagina of a healthy adult woman. Types a, b and c: epithelial cells, few leukocytes (according to the phase of the menstrual cycle) Doederlein bacilli. Type d transition type. There is an increase in the number of leukocytes and bacilli.

II. Nonpurulent bacterial discharges (Type a). epithelial cells, few leukocytes and Doederlein bacilli, varied flora of bacilli and cocci. Type b Vibri type. Type c transition type semipurulent non leukocytes.

III. Purulent bacterial discharges. Type a. few epithelial cells, many leukocytes, varied flora of bacilli and cocci. Type b Streptococcal type. Type c Spirochaeta and fusiform bacteria type or both. Type d leptothrix type.

IV. Gonorrheal discharge. Type a acute Type b chronic.

V. Trichomonas discharge. Type a fresh infection, many leukocytes, scanty Doederlein bacilli more or less trichomonads. Type b culminating infection, abundant trichomonads and leukocytes, varied flora of bacilli and cocci. Type c chronic or latent infection (few trichomonads, few leukocytes, otherwise similar to type IIa).

VI. Vaginal mycosis. (Type a) nonpurulent mycosis few leukocytes, bacilli Doederlein, few epithelial cells and some kinds of pseudomycellium and candidium. Type b purulent mycosis many leukocytes, the rest like type a.

For the clinician it is quite sufficient to remember the basic groups (I VI) because the microbiologist informs him in slogans e. g. microbiologic smear II vibrio or microbiologic smear V fresh infection. The authors' experiences showed that nowadays we cannot do without a classification of the vaginal biocenosis from the broader microbiological viewpoint and that the treatment should be scientifically causal.

MISCELLANEOUS

Menstrual Toxin. Experimental Studies. O. Watkins Smith. *Am. J. Obst.* 947 541: 50

The atypical ergobulin derived from the endometrium during its late stages of retrogression is experimentally a powerful tissue damaging agent, capable also of inducing endocrine changes indicative of increased secretion and release of gonadotropic as well as of adrenotropic hormones. Immunologic studies suggest that this menstrual toxin and Menkin's canine necrocin are probably identical, which brings into close relationship the tissue damage in a species from different causes.

Fibrinolytic activity has been demonstrated to be closely associated with menstrual toxin and canine necrocin, and fibrinolyxin has been found in the circulating blood during menstruation, labor and the

toxemia of pregnancy also following surgery and in human pleural and peritoneal exudates

The pseudoglobulin fractions of all these fibrinolytic containing fluids, with the exception of the circulating blood following surgery have the property of prolonging the survival time and even occasionally of saving the lives of immature rats given minimal lethal doses of menstrual toxin. This property requires painstaking controlled experiments for its demonstration. Concentration of the pseudoglobulins is necessary. Protection appears to be a matter of quantitatively neutralizing the toxin and not of antibody formation in the ordinary immunologic sense

JAMES R. WOLFE, M.D.

Actinomycosis of the Internal Female Genitalia.
Report of 2 Cases. Everett M. Baker. *West J Surg* 1947 55 502

Actinomycosis may involve almost any organ of the body but comparatively few cases of this condition have been reported. A comprehensive review of the literature on this disease of the ovary and internal female genitalia has recently been made by the author

Actinomycosis of the ovary is a relatively rare disease. It is an infectious granulomatous disease characterized by the destruction of tissue suppuration, and an overgrowth of fibrous tissue. Most of the reported cases have been in the right ovary

The diagnosis is not easy even during laparotomy. The pockets of pus containing the ray fungus may not be clearly evident. The pathology resembles that of a neoplasm but being essentially inflammatory search for the elements of inflammation is imperative. Microscopic examination often fails to bring out the fungus immediately. The organism is slow in its invasion and slow in producing symptoms. A previous history of appendicitis or of a pelvic operation with an unusually slow and stormy recovery should make one suspicious of pelvic actinomycosis

Many types of treatment have been offered but the most important factor is early diagnosis.

Two cases of pelvic actinomycosis are reported in detail.

HARRY W. FICK, M.D.

Hemorrhages in the Menopause—the Clinical Significance of an Endometrium with Signs of Hormonal Influence (Ueber Blutungen in der Menopause. Speziell der klinischen Bedeutung eines Endometriums mit Zeichen hormonaler Beeinflussung). *Acta obst. gyna. scand* 1947 27 Supp. 6

The pathogenesis of postmenopausal vaginal hemorrhage particularly in patients in whom the endometrium shows signs of response to hormonal stimulation is discussed. Only patients who have been in the menopause for at least a year are considered. The necessity of excluding the presence of a malignant tumor in these cases is emphasized

The problems involved in the classification of different types of endometrial hyperplasia and their microscopic appearance having been discussed at

tention is called to the importance of differentiating the curettings from the endometrium which shows signs of response to hormonal stimulation from those taken in the presence of retrogressive hyperplasia or a uterine polyp. The latter have not been given sufficient prominence in the literature concerning endometrial hyperplasia in the menopause. The differentiation is difficult but may be materially facilitated by co-operation between the gynecologist and the pathologist and by constant examination of the uterine cavity with a uterine canal forceps. Attention is drawn to the microscopic details which in the experience of the Radimhemmet make the diagnosis of a uterine polyp from curettings possible

The literature concerning the etiology of an endometrial hyperplasia in the menopause is carefully studied particularly with regard to the coincidence between this condition and ovarian tumors of different types. A thorough description is given of the estrogen findings in the urine from patients with granulosa cell and theca cell tumors

One hundred and forty-eight cases of postmenopausal bleeding are presented in which the uterine mucosa showed signs of response to hormonal stimulation. The classification of the patients is made with reference to the following data noted at the first examination

- 1 Those with an ovarian tumor (30)
- 2 Those with a history of previous treatment with estrogenic hormones for a fairly long period or in considerably large doses (31)
- 3 Those without an ovarian tumor and without a history of previous treatment with estrogenic hormones (87). These are classified with reference to the history of their last menstrual period: less than 2 years previous to the postmenopausal bleeding (28) and more than 2 years (59). The reason for this grouping is that the cessations of the uterine and the ovarian cycles do not correlate with the menopause and that, consequently, bleedings of climacteric type may occur during the first years after the menopause

Thirty-six patients were in the menopause less than 2 years and received no treatment with estrogenic hormones. In 8 of these an ovarian tumor was present at the first examination. Only in 2 of the remaining 28 patients was an ovarian tumor noted later. The different microscopic appearance of the endometrium is briefly discussed

A close study is made of 81 patients who were in the menopause for more than 2 years and had received no treatment with estrogenic hormones. In 22 of these an ovarian tumor was present at the first examination. Of the 81 patients 70 were of great interest with regard to the pathogenesis of the endometrium which showed signs of response to hormonal stimulation in the menopause. The remaining 11 patients are not further discussed because

- 1 It was impossible to decide if disintegrated pieces of an endometrial hyperplasia or only of an endometrial polyp were present in the curettings (8)
- 2 No biopsy of the uterine mucosa was made (2)

3 It was impossible to decide the nature of the amenorrhea (1). The patient had been treated for several years with roentgen rays and the possibility of a temporary sterilization could not be excluded.

The microscopic appearance of the uterine mucosa in the 70 cases mentioned is discussed and a detailed account of the clinical course is given. In view of the clinical course and of the sex hormone findings in the urine it is most probable that ovarian tumors were present in at least 65 of the 70 patients (92.9%). In 53 of these 70 patients a laparotomy was performed. Microscopic verification of the ovarian tumors was available in 49 lesions: 43 granulosa cell or theca cell tumors (85.7%) 1 luteinoma (2%) 3 pseudomucinous papillary cystadenomas (6.1%) and 3 malignant papillary cystadenomas or adenocarcinomas of the ovary (6.1%). Three of the 49 ovarian tumors were histologically malignant and 5 were clinically malignant: 11.9 per cent of the granulosa cell tumors were clinically malignant.

The Radiumhemmet series of postmenopausal bleedings includes 90 cases in which clinical and histological examinations revealed nothing but a uterine polyp. Two of the patients were previously operated upon for carcinoma of the stomach and later developed metastases in both ovaries. A third patient has not been traced. Two of the remaining 87 patients later developed an ovarian tumor (2.3%). The considerable difference between the appearance of an ovarian tumor in patients with nothing but polyps (2.3%) and that of such a tumor in patients with endometrial hyperplasia (92.9%) obviously demonstrates the importance of a proper microscopic interpretation of the curettings.

In 8 of the 51 granulosa cell and theca cell tumors included among the 148 patients, there was a coincident adenocarcinoma of the fundus uteri (5.4%). 2 of these were histologically verified and 6 were considered as Group IX in the classification of Roser and Wall.

Three of the 8 patients were subjected to repeated curettage and it was noticed that the epithelial cells became increasingly atypical. The experience at the Radiumhemmet differs from that of Nakvak and Taylor who believe that the proliferative forces responsible for benign hyperplasia may predispose to the development of cancer.

In agreement with what has been stated before, it is advisable to submit to laparotomy all patients whose uterine mucosa shows evident signs of response to hormonal stimulation after being in the menopause for 2 years and who have received no treatment with estrogenic hormones. In cases in which it is impossible to perform a laparotomy radiological treatment is indicated. Granulosa cell tumors may be very radiosensitive.

The patients in whom it is impossible to differentiate between an endometrium with signs of response to hormonal stimulation and disintegrated pieces of an endometrial polyp should be kept under observation.

The connection between the type of the supplied estrogenic hormone and the microscopic appearance of the uterine mucosa is discussed.

Analysis is made of the estrogenic hormones in the urine from patients in the menopause. An increased amount signifies the presence of a granulosa or theca cell tumor.

PREGNANCY AND ITS COMPLICATIONS

OBSTETRICS

Clinical Statistical Study of Cases of Hyperemesis and Eclampsia Observed in the Clinic of Siena during the Period from 1929 to 1943 (Considerazioni clinico-statistiche sui casi di iperemesi e di eclampsia osservati nella Clinica di Siena nel quinquennio 1929-1943) *Arch. scien. clin.*, 1946 51 173

Three theories of the pathogenesis of hyperemesis and eclampsia may be distinguished (1) the placental, (2) the endocrine and (3) the theory based on alterations of the autonomic nervous system. Innumerable intermediate theories have also been advanced.

During the period from 1929 to 1943 35 cases of hyperemesis and 70 cases of eclampsia were observed in the Clinic of Siena. Hyperemesis was recorded in 0.3 per cent and eclampsia in 0.9 per cent of the entire obstetrical material. Of the 70 cases of eclampsia 8 occurred during pregnancy, 5 toward the end of pregnancy, 38 during the labor, and 19 in the puerperium. The predominance of cases during labor may be attributed to the untoward effect on the liver and kidneys of the effort of the organism to expel the fetus.

Recovery was recorded in 47 cases or 67.1 per cent. Twenty-seven patients who recovered had the eclampsia in labor, 11 in the puerperium, 5 during pregnancy, and 4 at termination of the pregnancy.

The percentage of the recoveries was higher in the women younger than 35 years than in older ones. Fatalities occurred in 17 cases, in 6 of older ones who had eclampsia in the puerperium, in 8 who had it during labor, and in 3 having it during pregnancy and in 1 patient who had it at the end of the pregnancy.

Operative procedures were employed in 46 patients: forceps accounting for 52.1 per cent of the operations, and version and extraction caesarean section, and induction of abortion accounting for the rest. Of 44 patients in whom forceps were applied 4 died. Of 12 patients who were subjected to version 5 died and of 6 who underwent caesarean section 1 expired.

Seventeen fetuses or 33.3 per cent, died. The author favors the placental theory of eclampsia which attributes the condition to autointoxication with poisonous substances originating from the fetus.

Hyperemesis is treated by the author symptomatically with sedatives, hormonal preparations, opiates and products causing hyperglycemia. In individualization is required because one drug may be efficient in one patient but not in another.

Eclampsia in the early stages is treated with venous section. Intravenous injection of magnesium sulfate, the administration of sodium sulfate by enema, and the use of decholin or other cholinergics or sedatives. In pronounced eclampsia in multiparas the

author recommends termination of the pregnancy through the vaginal route by podalic version, the application of forceps, or craniotomy. In primiparas the author advocates caesarean section.

ARTHUR F. CIPOLLA, M.D.
Acad. med.
 Tuberculosis and Pregnancy I. *Ruhm. Acad. med.* 1947 138: Supp. 197

In the beginning of the twentieth century pregnancy was generally considered to have a deleterious influence on tuberculous women. By and by, investigators altered the opinion as to this problem. Even nowadays however the majority of authors are of the opinion that pregnancy might influence tuberculosis, while the minority consider the tuberculous process to be independent of pregnancy. It has been pointed out that progression may occur post partum especially in cases with cavities. This is attributed to the descent of the diaphragm after delivery and the forced ventilation in connection with labor itself. Further it is stated that progression might be prevented by collapse treatment, e.g. pneumothorax or thoracoplasty.

The author has collected during pregnancy Dispersary of Stockholm. Parturition occurred in the year 1945 and the patients were controlled before pregnancy throughout gestation and after delivery.

The material comprises 121 patients, 115 of whom were not subjected to surgical treatment. There are 5 with pneumothorax and 1 patient with thoracoplasty. In the 115 cases first mentioned the tuberculous process was stationary in 83 per cent during pregnancy and the control period afterward. Progression was seen in 7 per cent and regression in 5 per cent. In 5 per cent both progression and regression were found.

As regards the cases with progression the tuberculous changes were benign. The fact that they frequently occurred immediately post partum indicates that the physical effort of the labor itself might play a certain role. Otherwise there would not be found among these patients that suggested that the pregnancy had any influence upon the tuberculous process. In the cases with regression improvement may begin before or after the patient has become pregnant as well as before or after delivery. The number of cases with more regression (57%) corresponds fairly well to that of those with more progression (72%). Thus it is evident that the alterations which occur now and then during pregnancy might well be ascribed to the usual clinical changes in tuberculosis.

In the 5 per cent in which progression alternated with regression during pregnancy there was no correspondence in the course of the changes. In these cases there was no marked deterioration post partum.

Lymphopathia Venereum Complicating Labor
 Irwin H. Kaiser and Edwin L. King. *Am J Obst.* 1947 54 219.

Lymphopathia venereum complicates pregnancy primarily by the inflammatory lesions it produces in the mother which impede the progress of labor. The dystocia produced by this disease falls into 2 anatomic groups. The first is caused by the elephantiasis esthiomene variety of vulvar lesions. Its management to now differs from that of similar soft tissue outlet dystocia due to other causes. The second type is caused by the extensive scarring of the soft tissues in the pelvis, of which the rectum is usually the first involved. This is due primarily to the virus and also to the usually associated secondary infection. The problems presented by this second type are unique in obstetrics.

This report is based on an analysis of 38 labors in 28 women with pelvic lymphopathia venereum observed at the Charity Hospital in New Orleans, Louisiana, between 1937 and 1946 plus a survey of 124 instances of this condition which appeared in the literature.

No individual is known to have had an exacerbation of the lymphopathia in association with pregnancy.

The 162 labors now recorded in the literature have a maternal mortality rate of 6 per cent but this figure appears to exaggerate the actual risk. Force in delivery has played a large role in the reported fatalities. Version and extraction is absolutely contraindicated. Death is usually due to rupture of the rectum or uterus, which may occur with spontaneous delivery.

If soft tissue scarring due to lymphopathia venereum is widespread in the pelvis, the patient should be delivered by cesarean section. A trial of labor may be permitted but if the presenting part fails to descend to the outlet, cesarean section rather than any form of pelvic delivery should be performed regardless of the dilatation of the cervix. If the patient delivers per vaginam she should be watched diligently for signs and symptoms of rupture of the uterus or rectum. The appearance of peritoneal irritation or shock should suggest exploratory laparotomy.

Colostomy in itself presents no special obstetric problem other than that found in other patients with pelvic lymphopathia venereum. In the 38 labors in the presence of lymphopathia venereum and rectal stricture observed in the Charity Hospital in New Orleans, there were no maternal deaths. Three cesarean sections were performed.

JOHN R. WOLFF, M.D.

Painless Labor with Continuous Caudal Analgesia
 (O parto indolor pela analgesia caudal continua)
 Francisco Cerruti and Menotti Laudisio. *Rev Paulista med.* 1946 29 1.

Using a steel needle, in preference to a catheter and 1 per cent novocain in physiologic salt solution at the rate of 30 drops per minute for the first 30

minutes and 15 drops per minute subsequently the authors tried the method of continuous caudal analgesia in 20 cases of labor and succeeded in introducing the anesthetic in 17. They found it impossible to pass the needle through the sacrococcygeal hiatus in 2 cases, and the needle perforated a vein of the epidural space in 1 case causing inundation of the sacral canal. Analgesia was complete in 13 cases and partial in 4. There were no accidents or complications and no fetal deaths. The largest quantity of anesthetic used was 350 c.c. and the smallest 50 c.c. The maximal duration of anesthesia was 6 hours and 25 minutes, the minimum 30 minutes. The authors draw the following conclusions.

Under continuous caudal analgesia a painless labor can be obtained in from 75 to 80 per cent of the cases. The anesthetic should be started when labor is in full swing with a cervical dilatation of not less than 3 to 4 cm. and the method should be used only in cases in which transpelvic delivery is possible.

Continuous caudal analgesia usually causes a decrease in the frequency of the uterine contractions with slight shortening of their length and according to the level of the cutaneous anesthesia may produce secondary inertia. Nevertheless delivery is not prolonged because anesthesia facilitates cervical dilatation and allows the fetal head to reach the pelvic floor more quickly.

The fetal head frequently stops at the perineum because the abdominal wall is anesthetized and the patient is unable to exert voluntary action. Kristeller's maneuver of expression eliminates this deficiency and becomes almost indispensable to delivery of the cephalic pole. However an abdominal belt was used in 2 cases and found to replace Kristeller's maneuver to advantage because it exerted more uniform pressure. When these artifices do not result in spontaneous delivery a low forceps may be applied. In occiput right posterior presentation the fetal head frequently reaches the perineum without the occurrence of internal rotation.

One of the greatest difficulties encountered in continuous caudal analgesia is the introduction of the needle into the sacral canal because edema of the region often covers up the sacrococcygeal triangle which is an indispensable reference point for the correct placing of the needle.

Uninterrupted observation of the patient is essential during the use of the method. In their cases the authors encountered a sudden rise of the cutaneous level of anesthesia, complete and rapid anesthesia with small quantities of anesthetic, a fall in the blood pressure and other occurrences which required the immediate intervention of the anesthetist.

The drip method is superior to the fractionated dose method because it is easy to change the number of drops used when this becomes necessary while 30 or 30 c.c. of anesthetic solution injected at one time cannot be withdrawn from the sacral canal. The method also allows the use of 2 tests: one to detect perforation of the dura mater the other to identify a wrongly placed needle.

variations in the rate of transfer of substances during different periods of pregnancy.

In women also the results of investigation following the intravenous injection of radioactive sodium showed that the rate of transfer of sodium per unit of weight of the placenta rose noticeably with the progress of pregnancy. The authors correlate certain morphological findings observed by them with this conclusion. They found that in the early stages of pregnancy the villi were relatively few but, at the same time large and thick walled and covered both by Langhans and by syncytial layers. In later stages the villi increased in number and at the same time became smaller and more thinly walled and without a Langhans layer.

By means of serial section examination of the placental tissue the authors endeavored to demonstrate the changes of villi or their vessels which might explain a raised permeability in the placental wall under certain conditions. Placentas were selected which showed marked structural changes grossly such as are often found in toxemic patients.

One such placenta from a woman with toxemia is described. The patient had been given a transfusion of blood containing ellipocytes before delivery and a number of the cells were seen to have gone over to the fetus. Several variously sized dark, blood filled foci stood out plainly in a microsection of the fixed placenta. The villi were considerably wider apart than in the normal placental tissue and their vessels were engorged with blood. Serial sections of a villus wall showed it growing thinner and thinner with the capillaries finally seen lying naked in the intervillous spaces at places the walls were indistinguishable between lightly packed fetal red cells which seemed to pass directly into the intervillous spaces of the mother. In places only a thin endothelial layer separated the fetal and maternal blood. Some sections demonstrated villi with walls without the syncytial layer. Gaps in the villus walls were seen filled with compact blood cells both fetal and maternal.

Infection experiments on placentas with sterile solutions of rice starch of a certain size of grain were

carried out. The umbilical vein of a fetus delivered by caesarean section (in the case of an induced abortion for medical reasons) was injected with the starch solution, the fetus being allowed to live while the blood was pumped around the body and into the placenta. Histological examination of the placenta revealed rice grains in the villous spaces. Villus wall none were seen in the villous spaces. Villus wall changes favoring the passage of substances from fetus to mother were noted.

PERRY B. CHASE, M.D.

The Results of Three 5 Year Studies of Hydatid Mole and Chorioepithelioma on the Pacific Coast. Albert W. Holman and Elizabeth H. Schirmer. *West J. Surg.*, 1947 55 545

This article is based on a combined 15 year study and includes the findings reported on 426 moles and 107 cases of chorioepitheliomas. 69 of the latter followed hydatid mole.

Hydatid mole in this series was not as common in patients over 40 years of age as it was thought to be by other observers. Hydatid mole is a disease of the ovum in early pregnancy. The teaching that excessive enlargement of the uterus occurs in the majority of cases of hydatid mole is false and should be discontinued. Curettage is preferable to hysterectomy in the treatment of hydatid mole. Hysterectomy and/or oophorectomy has no place in the treatment of hydatid mole. Chorioepithelioma, occurring several years following hydatid mole or pregnancy is the result of an intervening abortion which has not been recognized.

Biologic pregnancy tests have not yet attained their proper place in the diagnosis and prognosis of hydatid mole and chorioepithelioma. Both positive and negative pregnancy tests should be repeated and verified in cases of hydatid mole and chorioepithelioma. Sufficient attention is not paid to the presence of lutein cysts of the ovary accompanying hydatid mole and chorioepithelioma. Oophorectomy is not necessary in the treatment of chorioepithelioma. Pulmonary metastases are the greatest single cause of death in chorioepithelioma.

CHARLES BARON, M.D.

by obstruction of the ureter with coagulum (6) median displacement of the upper part of the ureter (7) spilling of the contrast medium outside the pelvis and renal parenchyma because of their rupture, (8) a negative image through lack of elimination of the medium, which would suggest a grave lesion of the parenchyma and (9) pleural effusion and decrease in the movements of the diaphragm on serial examination during the subsequent days.

Retrograde pyelography may be contraindicated by the seriousness of the clinical picture. In addition it may increase the hemorrhage and carry infection to the kidney. Cystoscopy, pyelography and the indigo carmine test to study the function of the opposite kidney should be used only in mild and average cases which are kept under observation in a specialized milieu. In an emergency service attended by general surgeons, intravenous urography constitutes a minimal requirement and should be omitted only in exceptional cases.

The expectant method should be reserved for minimal local and general pictures which represent closed lesions of the type of simple contusions or small parenchymatous fissures without rupture of the capsule, calices, or pelvis. Descending urography showing the absence of extravasation of contrast medium will militate in favor of expectation as will also congenital absence of the opposite kidney even in the presence of persistent hemorrhage.

When the acute clinical picture demands it (frank anemia, hypotension, hematuria, palpable hematoma) after treatment of shock and if possible intravenous urography exploratory lumbarotomy is performed or laparotomy when associated lesions are suspected. Without going to the extreme of conservation at all cost, the kidney must be respected if there is any possibility of functional recovery even cortical lesions reaching the calices may be closed with careful sutures preferably of ribbon gut (Loweley and Menning) or including a piece of muscle or fat in the line of suture to give it greater strength. In other cases it will be necessary to take recourse to partial resection, heminephrectomy or even nephrectomy in the presence of a pathologic kidney.

When the conservative procedure is pushed too far and is used in extensive parenchymatous wounds, abundant scarring may later be responsible for serious complications which may reach obstructive hydronephrosis, calculus formation, pyonephrosis, perinephritis and final atrophy of the kidney. But when the conservative method follows the classical indications and is used in fissures of the parenchyma even with reparable wounds of the pelvis, it is rewarded by immediate successful results and by absence of late complications.

Nephrectomy the operation of choice gives the best immediate and late results. It is indicated in great destructions of the parenchyma, detachments of the pedicle and irreparable lesions of the pelvis and/or ureter. In open lesions from cutting instruments or firearms with abdominal or lumbar injury surgical intervention is indispensable as soon

as shock has been overcome. The operation may or may not be started with a laparotomy to attend to the associated intestinal, hepatic, or other lesions and the kidney may be approached through the same incision or through lumbarotomy. In wounds from cutting instruments it will often be possible to suture the parenchyma. Wounds from fragments of grenades or bombs and the presence of pieces of clothes and of soil in the tissues will indicate immediate debridement, resection of the tract, removal of the foreign bodies and treatment of the renal lesion.

RICHARD KEMML, M.D.

Contribution to the Diagnosis and Treatment of Papilloma of the Renal Pelvis (Ein Beitrag zur Erkennung und Behandlung des Nierenbeckenpapilloma) Kurt Tschirntsch, *Deut. med. Wochschr.* 1947 72: 442

Papilloma of the renal pelvis is extremely rare. According to European and American statistics its incidence is about 0.65 per cent among all kidney tumors. Only 200 cases have been published in the entire literature. Histologically and biologically it is closely related to warts. Patients with papillomas of the urinary tract often also reveal papillomas of the skin.

The main clinical symptoms are hematuria and pain which in most cases occur in attacks starting and stopping abruptly. It is difficult to make the correct diagnosis prior to surgery and to differentiate the papilloma clinically from other forms of pathology in the kidney pelvis (parenchymatous tumors, calculi). However the diagnosis can be established if tumor tissue is found in urine obtained by catheterization of the ureter. Also, when villi from the papilloma are found in the voided urine and cystoscopy reveals the absence of papillomas in the bladder the diagnosis is certain. It has been shown that villi from the diseased portion can get into the healthy kidney by reflux and thus may cause diagnostic errors as to the site of the tumor. The most valuable help in the diagnosis is retrograde pyelography, especially in early cases. Later on when hydronephrosis or pyonephrosis has developed the filling defects fail to show up in the pyelogram. However the pyelogram is not infallible. Very small papillomas may be overlooked, or soft calculi or coagulated blood may be mistaken for tumors.

The only effective treatment is surgery. The author is opposed to pyelotomy or nephrotomy because of the danger that very small papillomas may be overlooked. Moreover the risk of dissemination and carcinomatous degeneration of the papillomas due to the operation is so great that conservative surgery is not justified. The only safe treatment is nephrectomy plus ureterectomy. The ureter should be removed in its total length including the intramural portion in the wall of the bladder. Recurrences and metastases in the ureter probably by way of implantation have frequently been observed.

The prognosis is not altogether good even in cases in which surgery was done at an early stage. The

question of malignancy in this seemingly benign tumor has been a subject of discussion for a long time. In 1914 Scholl of the Mayo Clinic reported 8 cases which were malignant clinically and histologically. Primary malignancy or secondary carcinomatous degeneration is estimated to occur in about 70 per cent of the cases. Recurrences and metastases occur usually within the first 3 years after surgery; late metastases seem to be rare.

The author reports a case of his own observation which was correctly diagnosed by retrograde pyelography.

WILLIAM M. SCHWARTZ, M.D.

A Clinical and Pathologic Anatomical Study of Tumors of the Kidney in Children Based on a Series of 18 Cases. Lino F. Vucok. *Acta chirurgica* 1947 95 333

The author reports 18 cases of tumors of the kidney in children from 2 months to 8 years of age. These cases are all from hospitals in Finland and none has previously been reported.

The first symptoms were listlessness, anorexia, weight loss, anemia, slight fever and rarely hematuria. In 17 children the tumor was discovered on admission. The period of time which had elapsed between the first appearance of symptoms and the diagnosis was from 1 day to 10 months, the average being 4 months. Wrong diagnosis, or failure to discover the tumor occurred once in 4 patients, twice likewise in 4 patients, three times in 1 patient and four times also in 1 patient. The time lost in this way was from 27 days to 10 months. The author stresses the rare and late metastases from these tumors and the late breakthrough of the renal capsule and encourages earlier diagnosis through an awareness of this disease on the part of those who treat the disease of children.

In the author's series nephrectomy was done transperitoneally in 5 patients and retroperitoneally in 13. He favors the former method as it allows for ligation of the renal vein before mobilizing the tumor.

Nine patients were given postoperative x-ray therapy but all died of recurrences. Of the total series 14 patients died of recurrence within the first 16 months after operation, 4 patients are still living after 18 months but 1 patient has already been found to have recurrence.

The tumors included both the nodular and solid, as well as the sarcomatous and papillary variety. Histologically they were 17 of 18 different types ranging from the most primitive sarcomatous forms to adenomatous varieties containing glomerular elements. The so-called capsule is regarded as a sclerotic layer of renal tissue.

JOSEPH F. MURPHY, M.D.

Primary Carcinoma of the Ureter. J. M. Hundley and J. A. Hunter. *J. Urol.* 1947 58 122

The authors present a case of carcinoma of the ureter to which the danger of retrograde extension to the renal pelvis from the "ureter" is emphasized. The authors state that although a low grade tumor either clinically or

pathologically and must be considered a malignant tumor.

The lesion is most common in the sixth and seventh decades and occurs in the male more often than in the female. The usual symptoms are hematuria, pain and a tumor mass. Pathologically primary carcinoma of the ureter is either papillary or papillary and spreads early and more extensively than a similar lesion of the bladder. Ureterectomy with segmental cystectomy and a retroperitoneal one-stage operation is the procedure of choice.

The case presented was that of a 56-year-old female who was admitted to the University Hospital of Baltimore, Maryland, complaining of hematuria for a week. A retrograde pyelogram showed a filling defect in the left ureter of kidney although the filling defect was from the left ureteral orifice. Nephrectomy and ureterectomy was done but the lower portion of the left ureter was not removed as it seemed to be uninvolved. The microscopic picture was that of benign papilloma of the ureter. Three months later cystoscopy revealed a growth projecting from the left orifice. The lower segment of the ureter was then removed and a large tumor was found. A recurrence at the lumbar incision was found also. The patient died 6 months after the pyelorectomy because of the recurrence and metastases.

JOSEPH E. MURPHY, M.D.

BLADDER, URETHRA, AND PENS

Visco-Rayopaque in Cystourethrography. C. F. Richards. *J. Urol.* 1947 58 113

Cystourethrography is a valuable diagnostic procedure which has not been generally used because of technical difficulty and because there has been no truly satisfactory medium. The author presents his experiences with a new water-soluble viscous radioopaque substance visco-rayopaque which he believes is safer and more efficient than any contrast media previously proposed for urethrography.

The cystourethrogram is helpful in the diagnosis of any condition which produces gross anatomical alteration in the contour of the bladder or ureter. It is an adjunct to the usual procedure of urethroscopy and in cases in which the patient is unable to undergo the procedure it may be the only approach to an accurate diagnosis of the present condition. Its outstanding advantage over cystourethrography is that it provides a permanent graphic record which may be compared with later studies to determine its value in evaluating the progress of the disease under consideration.

Viscourethrography is a roentgenogram of the bladder and urethra where cultures have been found to be present in the prostatic urethra. The authors state that contrast medium is not present in the ureter when an opaque cystogram is obtained. The authors believe that a satisfactory method of urethrography can be achieved by the use of visco-rayopaque.

the attributes of the ideal cystographic medium but it must in addition be somewhat more radio-opaque and also considerably more viscous. The necessity for increased radio-opacity is due to the fact that x-rays in passing through the urethra, are interrupted by such a relatively shallow column of the contrast medium that to produce a satisfactory roentgenogram, this thin layer of medium must be almost totally opaque to the rays at the required exposure. Also, the changes in structural pathology encountered in this region are frequently so delicate that the urethrogram must have an exceedingly sharp and detailed outline demonstrating the most minute anatomical abnormality.

The necessity for increased viscosity is due to the fact that, when at rest, certain segments of the normal urethra are occluded by the sphincters and the pressure of the surrounding tissue. To completely visualize these segments on a roentgenogram it is necessary to expose the x-ray film while they are temporarily opened by the flow of an opaque medium through their lumina. This may be accomplished either by voiding the medium from the bladder or by injecting it retrograde through the urethral meatus at the time of exposure. However for the column of opaque material which is passing relatively slowly through these segments of the urethra to open them sufficiently to produce a satisfactory outline the opaque material must have a viscosity many times that of ordinary aqueous solutions.

Up to recently, the substances which were most frequently used for urethrography contained some type of an iodized oil. They had a tendency to be somewhat irritating to the mucosa of the urethra, due to free iodine being liberated from the compound when exposed to air, light, or high temperature. Furthermore, having an oil base, there were certain inherent disadvantages to any nonwater soluble agent inasmuch as they are not miscible with the urine and sometimes produce an irregular outline due to globules of the dye mixed with the urine or aqueous cystographic medium. The most serious objection to the iodized oils is the possibility of introducing some of the medium into the general circulation, producing a fat embolus.

Visco-rayopake is an experimental organic iodide developed recently as a radiocontrast medium. It seems to be a substance which meets every requirement for the perfect urethrographic contrast medium. It is more viscous than any of the previously proposed media. It produces sharper outlines and better detail than any other, except perhaps the iodized oil. It seems to possess all the advantages of the iodized oil and at the same time has none of their potential dangers and disadvantages. It is water-soluble and therefore miscible with urine and aqueous cystographic media. Most important of all its use carries no risk of fat embolus or general systemic defect even if it should inadvertently be introduced into the circulation during urethral injection. The authors have used visco-rayopake in 54 patients with excellent results. They have experienced no evidence of local

or generalized irritation or toxicity, nor has there been anything suggestive of an allergic phenomenon. There have been no reports in the literature of any type of serious reaction to this substance.

The author outlines the usual procedure for making cystourethrograms as follows:

1. Adequate preparation of the patient with purgatives and enemas.
2. The patient empties his bladder as completely as possible.
3. A plain x-ray of the abdomen is made.
4. A small soft rubber urethral catheter is introduced into the bladder and the residual urine, if any, is measured.
5. A 2 to 4 per cent solution of sodium iodide is introduced into the bladder, the amount and the concentration varying with the circumstances.
6. The catheter is withdrawn, leaving the iodide solution in the bladder.
7. With the patient in the supine position, 25 c.c. of visco-rayopake is injected slowly into the urethra, the last 5 c.c. during the exposure of the film. Having the patient relax completely and attempt to void facilitates this injection by opening the external urethral sphincter. The x-ray tube is centered directly over the symphysis pubis.
8. With the urethral meatus occluded the patient turns on his side so that the pelvis is at a 45 degree angle to the vertical plane, the lower thigh and leg in complete flexion and the upper thigh and leg in complete extension. A film is exposed in this oblique position during the injection of an additional 5 c.c. of contrast medium.

9. The patient voids. If there is more than 50 c.c. residual left in the bladder, a catheter is passed at the end of the procedure to remove the remaining sodium iodide solution.

In a large majority of patients, these two views will give all the desired information. If a very sharp outline of the bladder is desired, a more concentrated solution is used. If a bladder filling defect is suspected, such as an enlarged prostate neoplasm, or nonopaque calculus, then a less concentrated solution is indicated. If one is interested primarily in delineating the bladder outline, a maximum amount of solution should be instilled. If one is looking for encroachment on the bladder's lumen, a smaller amount of solution would be instilled.

The author concludes that visco-rayopake is believed to be the safest and most efficient urographic contrast medium yet produced.

ROBERT O. BEADLES, M.D.

Carcinoma of the Bladder James T. Priestley, J.
Am. J. Surg., 1947, 134, 507

Many factors must be considered in deciding on the most desirable type of treatment for a patient who has carcinoma of the bladder. These include the size, grade, and location of the lesion, the degree of infiltration, whether the lesion is single or multiple, whether the ureterovesical orifice is involved on one or both sides, the status of renal function, the

with a certain amount of giant cells. These nodules resembled tubercles however no trace of caseation was found. Furthermore the giant cells were not of the Langhans type with horseshoe arrangement of the nuclei rather they resembled foreign body giant cells, their nuclei being arranged more to the center of the cell. Closer investigation revealed that the cytoplasm of the giant cells as well as the epithelioid cells contained numerous small droplets of a fatty substance which obviously was paraffin. Similar findings were revealed in a later biopsy from the edge of the ulceration.

In a series of 6 interventions, the paraffinoma was excised and a penis of normal length and shape formed by transplantation of skin from the pubic region. The result was satisfactory from the anatomical as well as the functional point of view.

It should be mentioned that the patient consistently denied ever having had an infection of paraffin however in view of the histological findings, there could be no doubt about the diagnosis.

WERNER M. SOLMITZ, M.D.

GENITAL ORGANS

Some Observations on Transurethral Prostatic Resection. Reed M. Nesbit. *A. England J. M.* 1947 837 207

The author emphasizes certain details of technique that have been found necessary to the successful execution of transurethral resection. This operation has been performed in the University of Michigan Hospital at Ann Arbor since October 1931 and experience has shown that prostatic resection possesses many attendant hazards and that there are numerous pitfalls in the performance of this technically difficult operation. Most of these can be considered under trauma and hemorrhage.

One of the most frequent causes of immediate and late complications is urethral trauma. When the urethra is traumatized by forceful introduction of rigid instruments that are too large there results an introduction of infection manifested by the development of local tenderness of the urethra and general sepsis. Later the development of stricture completes the cycle and may leave the patient with a lesion which is just as debilitating and infinitely more difficult to treat than prostatism. Urethral trauma is usually avoided if the surgeon does not introduce the standard size resectoscope into the urethra which fails to accommodate easily a No. 30 Fr. steel sound. When smaller urethras are encountered one may use a resectoscope having a sheath of smaller than standard diameter. If this is impractical, the surgeon has two procedures that can be followed: (1) meatotomy will often permit the passage of the resectoscope; however in some cases the remainder of the urethra is too small and then perineal urethrotomy is indicated. At the University of Michigan Hospital, approximately 35 per cent of the patients operated on by resection require meatotomy whereas perineal urethrotomy is performed in 20 per cent.

Other indications for perineal urethrotomy include (1) severe urethritis (2) shortness of the penile suspensory ligament (3) excessive length of the prostatic urethra (4) abnormal position of the prostatic gland. In performing resection on large glands that is those in which 50 gm. or more of tissue is removed, urethrotomy is used in 30 per cent of the cases, in comparison to 20 per cent of all cases. In the resection of large glands the procedure allows an increased maneuverability that has facilitated the technique of operation.

It can be accepted as an axiom of transurethral surgery that the resectoscope must be freely and easily contained by the urethra at all times. Single exception to this rule is when the instrument is held tightly in the prostatic urethra by cancer or by contraction of the vesical neck. Whenever perineal urethrotomy is indicated to effect this purpose it should be done, for it is simple to perform and the patients suffer little or no inconvenience from it. They rarely pass urine through the incision and none develops stricture at the site of operation.

Another form of trauma occurs when the resectionist cuts too deeply into vulnerable areas. The most frequent are perforation of the prostatic capsule and injury of the external urinary sphincter. Minor perforations rarely give rise to morbidity and are probably of little clinical significance. Healing of the defect probably takes place quite rapidly and is enhanced by the catheter diversion of the urine. Extensive perforation however may give rise to pelvic cellulitis and extravasation and if not recognized and promptly treated by adequate drainage will terminate fatally.

Urinary incontinence following resection occurs when the external sphincter is cut with the resectoscope and is a complication which can be avoided even by the inexperienced resectionist if due care is exercised in the performance of a sound technique. Except in the presence of infiltrating cancer or inflammatory contracture that involves the membranous urethra, the proximal margin of the external sphincter can be recognized by certain anatomic properties of the structures that go to make up the area. The membranous urethra is an immobile structure whereas the adjoining prostatic urethra is slightly mobile, but the mucosa of each structure is tightly adherent. When the prostate gland is moved the surface configuration at the prostatomembranous juncture is altered by wrinkling in a manner comparable to the wrinkling of the bellows that connects two Pullman cars. The mucosal folds that are created in this manner are transversely disposed and extend around the entire circumference of the urethra. They can be recognized easily when observed through the resectoscope and are brought into view most effectively if the instrument is moved in and out through a short excursion while the area is being inspected. Fortunately this wrinkling phenomenon tends to increase as the transurethral resection progresses because of the increased mobility of the gland that is effected by the operation so that the surgeon can al-

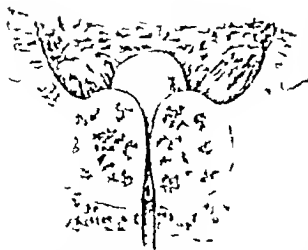


Fig. 1. Diagram showing of tract in a bladder outlet produced by hypertrophy of the lateral lobes and median lobe of prostate.

ways demonstrate that the prostatic membranous junction toward the end of the operation and can safely excise it all down to that point without fear of sphincter damage.

Hemorrhage in every prostate resection is accompanied by blood loss, and it is important that the surgeon have more or less accurate information regarding the amount of blood loss. A method of estimation of blood loss is described by the author in 1931 and provides the surgeon with objective data regarding the patient's need for replacement therapy.

The successful control of bleeding during the operation depends on certain details of technique which are acquired with experience. Bleeders are easily recognized and quickly arrested when the walls of the prostate are exposed. The incision for the resection is made rapidly to traverse the entire operative field in a variety of ways at the membranous urethra but then the operation is irregular and the anastomosis is irregular. The irregular surface tends to increase the difficulties by enhancing the formation of clots which in turn conceal anastomosis in blood. The experienced resectionist takes care to keep each exposure of the cut surface extended full length of the adenomatous mass that is being resected. When long masses of tissue are to be excised the operator while cutting may find the path of the instrument toward himself with the lower extremities that larger slices of tissue than would otherwise be permitted by the full exposure of the field can be excised. When the distal end of the adenomatous mass comes into view the resection of the mass is stopped and the cut surface is exposed forward and small fragments of tissue are cut off. The fragment of tissue is then held in the stream of water and with a sharp instrument a small piece of tissue is removed from the

excavation and the operator can examine the tissue within the excavation or continue to remove his cutting maneuvers. By a technique of this kind the cut surface can be kept smooth and the bleeding point and blood clot is removed.

The injection of various substances into the prostate gland to prevent bleeding during operation is not recommended.

Postoperative control of bleeding presents a problem, and it was formerly the practice of the author to irrigate the bladder with water every 1 or 15 minutes during the first 24 hours after operation. In the past 2 years this was replaced by the instillation of thrombin into the prostate gland. The discontinuance of postoperative irrigation in a running comparative series, it was found that the elimination of irrigation was the factor of greatest importance in controlling the postoperative bleeding. Consequently at this time the author does not irrigate after resection. With this there have been fewer cases of catheterization ever before.

Operative Technique The author presents a résumé of the technique that has been employed in prostate resection. In this procedure there are three phases of operation. In the first phase of the operation the apex of the prostate is removed. The apex of the prostate is the apex of the internal vesical sphincter. The second phase consists of removal of the remaining structures from within the prostate gland. The third phase consists of removal of the remaining structures touching the internal urethra.

In the first phase the resectoscope is used to enable inspection of the anterior wall of the prostate urethra. The anterior commissure is seen and one of the masses of the lateral lobes is found to bulge prominently more than the other. The field of vision. This one is chosen for the beginning of the operation. The external cut is brought into contact with the external urethral orifice. The incision is made in the urethra and along with the resectoscope and a fragment of tissue extending the full length of the lateral lobes is excised in all of its extent.

The observation of the morphology of the prostate is of primary importance for it is in this manner that the surgeon gauges the extent of what should be excised. The prostate is a mass of tissue which have a characteristic appearance. It varies only when there is a cystic lesion or a stricture. The appearance of the prostate is different from that of other tissues. The adenomatous prostate gland. It has a soft appearance when viewed through the resectoscope. The internal urethral orifice is surrounded by its circular muscle fibers. The prostate has a firm appearance and is not easily cut.

When a resection is only performed in the first phase of the operation a third phase of the

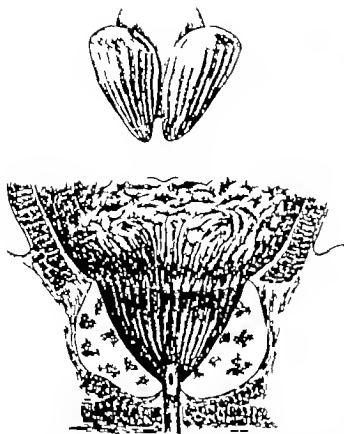


Fig. 2. Diagram showing cone-shaped area left after first phase of operation has been completed. Although a large part of the median and lateral lobes has been removed, there still remains much prostatic tissue to be removed from concave prostatic fossa.

can safely be excised in the same line, but if muscle fibers are recognized at the inner end of the furrow the operator must cut no deeper at that point. Instead the resectoscope is rotated a few degrees laterally so as to begin its next excision of tissue fragment. This slice of tissue and each successive one extend like the first fragment, the full length of the gland and the furrow that is formed by the second cutting stroke is confluent with the first, and like the first furrow is deepened until circular fibers of the internal sphincter are encountered then the resectoscope is again rotated a few degrees and another adjoining furrow is made. It is noteworthy that each of the successive cuts exposes a small arc of internal sphincter but that the individual furrows extending toward the apex of the prostate converge at a point, for the membranous urethra is a fixed point. The confluent furrows that successively expose the circumference of the internal sphincter create a cleft extending from that circle out to the apex, and the cleft that is created in the manner described often encircles the whole mass of prostate. These masses are composed of portions of the lateral lobes and of the median lobe, and when encircled as described and cut off from the peripheral circulation the entire mass can be cut up into fragments quickly and bloodlessly. In the resection of small obstructing glands or contrac-



Fig. 3. Diagram showing how prostatic tissue is removed from concave fossa down to capsule of prostate. At conclusion of this second phase of operation there remains only some prostatic tissue at apex of gland adjacent to and just above external voluntary sphincter muscle. In the third stage of operation this remaining tissue at apex of prostate gland is removed.

tures, the cutting maneuvers in the first zone of operation often entail only the removal of a shallow depth of tissue so that there may be no encirclement of a tissue mass. When the first phase of operation has been concluded there is a cone-shaped space extending from the apex of the gland to the circle described by the internal vesical sphincter. The walls of this cone are smooth and are composed of prostatic tissue, and any bleeding points are easy to identify.

The second phase of operation is concerned with the removal of adenomatous tissue from the concave prostatic fossa. In this zone the cutting loop enters the prostatic mass distal to the circular fibers of the internal sphincter and each excursion of the loop extends almost to the external sphincter where a small mass of tissue is allowed to remain as a bulwark against injury of the sphincter. In this zone the first cut is made anteriorly and successive cuts are made in the same furrow until the capsular structures are recognized. Successive cuts are made lateral to the original furrow until capsular structures come into view and dissection is continued with the object of creating a cleft that is peripheral to the adenomatous mass of tissue. Digital palpation of the gland during the resection within the posterior half of the fossa is essential to accurate and safe dissection. With a finger in the rectum the surgeon is able to palpate quite accurately the thickness of the adenoma and when nodular masses are relatively inaccessible because of unusual position, to push them upward into the path of the cutting loop. By peripheral dissection in the second zone of operation the adenomatous mass is devascularized so that the free mass that is finally isolated on the floor of the urethra can be expeditiously and safely excised by rapid resection.

At the conclusion of the second phase of operation the surgeon is able to view the entire fossa from the vantage point at the apex of the gland. In the distance he can see the denuded internal sphincter and in the foreground he is able to inspect the smooth concave wall of the prostatic fossa. Bleeding points are readily discovered.

The final phase of operation requires a meticulous and careful dissection for it is now that the surgeon resects all tissues down to the margin of the external sphincter. This margin is readily identified as described above by observation of the transverse fold or wrinkle that is made visible when the resectoscope is moved in and out and rotated while the area in question is inspected. When the outer margin of safe resection has been delineated throughout its entire circumference, the excision of apical tissue can be carried out as far as this line. The resection is started anteriorly; the instrument is then rotated a successive adjoining fragments of the gland are excised until the ejaculatory ducts and the crumumontanum are reached but these structures are not removed. Although the apex of the adenomatous gland is tapered in form and ends at the triangular ligament it often extends laterally for some distance on this abutment and resection at the apex must extend not only down to the urethral level but also deeper on each side of the midline so as to include the removal of all adenomatous tissue contained within the capsule. This is greatly facilitated by rectal palpation. By employing a systematic approach in the technique of transurethral resection the urologist is enabled to perform a subtotal removal of the prostate

gland and the size of the gland that is removed depends in a large measure on the factors of experience and experience in the performance of the operation. The author cautions that subtotal prostatectomy is essential to the attainment of consistently good results and when this objective cannot be attained by the urologist it would be well to treat the patient by a caudative procedure for the cure of prostatic hyperplasia depends on the extirpation of the gland.

ROBERT O. BARNES, M.D.

Spontaneous Torsion of the Testicle (Torsione spontanea del testicolo) Mario Raffaele, *Arch. Ital. Urol.* 1947 69 73

In a series of 18 cases of spontaneous torsion of the testicle seen between 1935 and 1945 the author found the greatest frequency between the ages 14 and 25.

An acute onset of pain and protrusion of the testis with swelling of the scrotum and a hard testis are significant for the diagnosis of torsion of the testicle. Transillumination and the finding of a serous material with an explorative puncture confirms the diagnosis.

Torsion if left alone will cause atrophy of the testicle. Although spontaneous torsion is rare it is an infrequent occurrence. The vitality of a twisted testicle ranges between 12 and 16 hours. The earlier the intervention the better the prognosis is.

Manual detorsion may be attempted but is a practical measure to resort to surgery as the only way to correct the condition.

ARMANDO C. CORTI, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Contribution to the Study of Eosinophilic Granulomas and Their Relation to Bony Xanthomas (Contribución al estudio del denominado "granuloma eosinofílico" y a sus relaciones con la xantomatosis ósea) Fritz Schafjowicz and Moisés Polak. *Rev. As. méd. argent.*, 1947 61: 318.

The authors maintain that the difficulty in classifying tumors of the reticuloendothelial system resolves into a lack of exact diagnosis, particularly by biopsy which will enable one to determine whether the lesion is inflammatory hyperplastic, or blastomatous whether it is a reticulosarcoma or the relatively benign hyperplasia of the reticulohistiocytes or whether one is dealing with the solitary granuloma of Otani and Ehrlich, the eosinophilic granuloma of Jaffe and Lichtenstein, or a solitary or multiple osseous xanthoma the latter with or without the Schueller Christian syndrome.

After citing the various factors the authors believe that there is no fixed criterion for classifying these lesions. Some consider them independent entities others related conditions. Eight cases are presented. The studies were confirmed by small biopsy specimens in some instances and in others by abundant material obtained from more extensive surgical procedures.

It was concluded that the lesions were remarkably similar and that the histiocytes are capable of forming fibroblasts or giant cells, can store lipoids, or may be accompanied by an eosinophilic reaction. Moreover it was established that there is a relation between histiocytic granuloma, with or without eosinophils the bony xanthoma, with or without the Schueller Christian syndrome, and Letterer-Siwe's disease. The inflammatory factor as causation of these lesions is stressed. Classification of the reticuloendothelial hyperplasia is appended.

STEPHEN A. ZIEGLER M.D.

Functional Aspects of the Abductor Muscles of the Hip Verne T. Inman *J. Bone Surg.* 1947 29: 607

In order to explain the various clinical observations in instances of derangement of the abductor muscles, the authors made a study of the forces acting in and around the hip joint. The reacting force in the head of the femur resists not merely the pressure of the superincumbent body weight, but, in addition the force of the abductor muscles and the tension on the iliotibial tract which is necessary to hold the pelvis in equilibrium. With the knowledge of the direction of the reacting force through the head and neck of the femur against the pelvis the changing angle of the capital epiphysis during growth becomes partially explainable. Close inspection of roent-

genograms of the upper end of the femur in individuals of various ages reveals that the epiphysal line always lies at a right angle to the direction of the medial trabeculae of the femoral neck. Since the reacting force in the femur follows these trabeculae there is no shear on the epiphysal cartilage. The only force to which it is subjected normally is a compressional one. As growth occurs, with increasing length of the femoral neck and increasing angle of pull of the abductor muscles and the fascia, the epiphysal cartilaginous plate rotates so as to lie perpendicular to the equilibrant force in the femoral neck.

The interrelationship of these forces becomes altered in cases of paralysis of the abductor muscles and in congenital dislocation of the hip. In the first instance the loss of muscle power prevents the attainment of equilibrium with the body in a normal position. To prevent the pelvis from rotating toward the nonweightbearing side the individual shifts his center of gravity over the affected hip by bending to that side. The resultant forces acting through the hip become more nearly vertical. The equilibrant or reacting force in the femoral neck likewise shifts toward the vertical; the epiphysal cartilaginous plate remaining perpendicular to these forces continues to be relatively horizontal and coxa valga results. This is a constant finding in individuals who have had paralysis early in life and the degree of coxa valga is in proportion to the loss of muscle power. Coxa valga occurs in individuals suffering from congenital dislocation of the hip for the same factors are at work. In these cases, the loss of fulcrum prevents the normal development of the abducting forces. The load is borne vertically on the femur and the capital epiphysis reacts by remaining horizontal. In malum coxae senilis the bone changes affect predominantly the superior aspect of the femoral head because the forces are concentrated there.

After the magnitude of the torque about the hip joint has been determined as the center of gravity of the body lies medial to the center of rotation of the hip it becomes possible to calculate the minimum pull of the abductor muscles and the amount of tension exercised by the iliotibial tract in counteracting this torque. Since the center of gravity necessarily lies in the median sagittal plane the torque is the product of the body weight and the distance from the median sagittal plane to the center of rotation of the femoral head. The determination of the experimental values of the torque about the hip joint on the weight-bearing side was based upon myographic recordings. Both skin and needle electrodes were utilized. The electrodes were placed in or over the tensor fasciae femoris the gluteus medius, and the gluteus minimus. The action currents were amplified by means of the Grass electroenceph-

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ROBERT O. BEAN, M.D.

Spontaneous Torsion of the Testicle (Torsione spontanea del testicolo) Mario Ballestrero. *Arch. ital. chir.* 1947 69 23

In a series of 18 cases of spontaneous torsion of the testicle seen between 1935 and 1945 the author found the greatest frequency between the ages of 15 and 17.

An acute onset of pain and prostration of the patient with swelling of the scrotum and a fluctuant mass are significant for the diagnosis of torsion of the testicle. Transillumination and the finding of a serous material with an explorative puncture confirm the diagnosis.

Torsion if left alone will cause atrophy of the testicle. Although spontaneous detorsion is possible it is an infrequent occurrence. The vitality of a twisted testicle ranges between 12 and 16 hours. The earlier the intervention the better the prognosis.

Manual detorsion may be attempted but is not a practical one must resort to surgery as the best way to correct this condition.

ARTHUR F. CIMOLA, M.D.

indics proprius into the tendinous expansion of the first dorsal interosaeus. Action of the extensor pollicis longus may be restored by transplanting the extensor indicis proprius or the extensor carpi radialis brevis (or longus) into the extensor pollicis longus. Transfer proximal to the wrist allows for normal oblique pull of the tendon around Lister's tubercle. A factor in diagnosis of function of the extensor pollicis longus is the ability to extend weakly the distal phalanx of the thumb by use of the extensor pollicis brevis. The authors prefer transfer of the extensor indicis proprius. Loss of action of the abductor pollicis longus and the extensor pollicis brevis may be corrected by transfer of the extensor carpi radialis brevis. The flexor pollicis longus is sometimes the only muscle paralyzed. Transfer of a sublimis tendon to the flexor pollicis longus is the only way to substitute a tendon of equivalent excursion. Transfer above the wrist is advised if the tendon itself is not damaged. Satisfactory function may be obtained by transferring the palmaris longus, flexor carpi radialis, wrist extensors, or the brachioradialis tendon. Occasionally mobility of the metacarpophalangeal joint of the thumb may be limited, and then an osteotomy, bone block, or other procedure should be performed before tendon surgery is considered. In instances of loss of profundus muscle function, satisfactory repair may be obtained by suture of the dysfunctional tendons to active tendons of the same type.

Tendinous reconstruction for permanent paralysis of the radial nerve gives good results. In cases of complete radial nerve palsy the pronator teres insertion is divided and transplanted into the radial wrist extensors. The flexor carpi ulnaris is transplanted into the extensors of the long finger, ring finger and little finger. The flexor carpi radialis is transplanted into the extensor pollicis longus and the extensor of the index finger. The palmaris longus is transplanted into the abductor pollicis longus and the extensor pollicis brevis. In cases of palsy of the dorsal interosaeus nerve only the same procedure is carried out with the exception of the pronator teres transfer. Occasionally, a patient may desire a more stable wrist than that afforded by tendon transplantation; this may be accomplished by wrist fusion after trial of tendon transplantation.

The ulnar nerve supplies most of the intrinsic muscles of the hand, but, unfortunately upon re-generation after physiological interruption or surgical suture, restoration of function of the small muscles does not always occur. A wide range of disability results, from very little interference of hand function to severe clawing of the fingers and loss of adduction of the thumb. If clawing is severe enough to warrant surgery the Bunnell type of sublimis tendon transfer to the extensor aponeurosis gives gratifying results in supple fingers. Transfers for adduction of the thumb were not performed in this series. Abduction of the index finger may be restored by transfer of the extensor indicis proprius.

Median nerve paralysis frequently results in loss of opposition of the thumb. Various procedures were

utilized especially that of subcutaneous transfer of the sublimis of the ring finger. The tendon is isolated at the wrist, severed at its insertion and rerouted under the flexor carpi ulnaris subcutaneously and one slip is inserted into the proximal end of the proximal phalanx and the other into the distal portion of the metacarpal.

Combined injury of the median and ulnar nerves poses a more formidable problem. Each condition must be carefully evaluated and existing functioning tendons transferred to the most important sites. In severe cases, primary arthrodesis of the wrist will allow the 3 wrist extensors to be transferred to the flexor surface for motivation of the thumb and fingers. In addition the brachioradialis tendon may be used. In such cases, preliminary surgery may be necessary to place the thumb in optimum position. Combined median and ulnar nerve injury frequently leads to malposition of the thumb and loss of free movement due to fibrosis. Opposition of the thumb has been partially restored by using the extensor carpi ulnaris as a motor. In cases falling into the ischemic contracture group contractures lead to gross deformity for which only a little can be done.

Brachial plexus injuries also have a wide variation of returning function. Spontaneous recovery or recovery following surgical interference must be evaluated. When maximum recovery is determined to have occurred improvement of function can be obtained by utilizing the principles incorporated previously.

Throughout this report valuable principles are given which must be considered if maximum benefit is to be derived. Excellent diagrams and photographs illustrate the various procedures. This report portrays activity in one army general hospital and reflects work performed at other similar installations.

KEMATH H. SPONKIE, M.D.

FRACTURES AND DISLOCATIONS

The Value of Patellectomy in the Treatment of Fractures of the Patella (*La place de la patellectomie dans le traitement des fractures de la rotule*)
Felix Lagrot and Jean Salasc. *Mém. Acad. chir.*,
Par 1947 73 361

This article is based on 4 recent simple transverse fractures of the patella and 1 old fracture of the patella associated with post traumatic arthritis all of which were treated with patellectomy. The patella was exposed by a longitudinal midline incision and removed by sharp dissection. The wound was then carefully closed layer by layer. No cast or other type of immobilization was used postoperatively. The patient was encouraged to raise his leg actively from the first postoperative day on 5 minutes in every hour. Full extension and flexion to 90 degrees was obtained within the first month after the operation.

The increased use of this rather radical procedure was the result of observations made by many surgeons that the conservative treatment of patellar

alograph and the output was passed through a voltage integrator to facilitate the estimation of the electric potential. The action potential was obtained as the individual bore all his weight on the limb to which the electrodes were applied. The opposite extremity was fixed at the hip and the knee joint sufficiently to clear the floor. The abductors need only be contracted to keep the pelvis level and the degree of contraction was recorded by means of the myograph.

It is quite apparent that when the subject is standing on one extremity with the pelvis level the force which prevents the pelvis from rotating about the supporting hip is not due entirely to muscle pull. A considerable amount of force is contributed by passive tension on the fascia lata and the iliofemoral tract. As the pelvis is depressed toward the non-weight-bearing side the fascial structures become increasingly taut and at some greater and greater degree of tension until a point is reached where little or no muscle contraction is required.

C. FRED GOEDENOW, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES TENDONS ETC.

The Repair of Defects of the Radius with Fibular Bone Grafts. Richard C. Miller and George S. Phalen. *J Bone & Jt Surg* 1947; 29:692.

There are both advantages and disadvantages in the use of fibular grafts. The fibular graft has the advantage of providing considerable stability to the grafted bone. Furthermore the fibula is approximately the same size as the radius so that ultimately, when healing is complete, the normal contour and probably the normal length of the radius have been restored. Finally the use of a fibular graft will avoid the infrequent but not infrequent complication of fracture through the tibial distal end. The primary disadvantage of the fibular graft is a relatively greater degree of density of cortical bone as compared to that of the radius. The osteogenic properties of the fibular graft are therefore not so great as those of a tibial or iliac graft. To offset this disadvantage it has been suggested that the drilling of multiple small holes throughout the graft might increase the vascularity and the rapidity of take. This procedure has not been employed in any of the cases presented.

Over a period of 15 months the author treated 16 patients with fibular bone grafts. In general the fibular grafts were 12 to 18 inches in length. The distal ends of the ulna were not resected in 13 of the 16 cases. In 3 of these 3 cases the radius was resected and consequently been greatly restricted. All of the patients in whom the radius was resected have recovered and have returned to work. The patients in whom the radius was not resected have recovered and have returned to work.

The author states that resection of the distal end of the radius was not indicated in the

graft operation. This procedure eliminated a procedure which would probably be necessary to restore rotation to the forearm and correct the deviation of the hand. In the authors' series there has not been a great deal of difference anatomically or functionally between the cases in which the ulna has been anchored to the distal radius and those in which it has been left free.

The fibular graft is obtained from a central incision preferably that on the side opposite the forearm to give the second surgical team more room in which to work. The fibular shaft is exposed and penetrated through a lateral longitudinal incision dissection being carried down along the posterior intermuscular septum between the peroneal and soleus muscles. Care is taken not to injure the muscles. A measured amount of fibula is then removed with a Gigli saw or osteotome. The length of the graft may be calculated before operation by adding 3 inches to the length of the radial defect. Initially as much of the fibula as desired may be removed; this may if necessary include the ends of the bone. It is, of course, necessary to preserve the peroneal nerve as it rounds the neck of the fibula. Distally at least 3 inches of the fibula must remain to maintain the stability of the ankle mortise. In the forearm it was found best to employ a distal radial incision. The superficial branch of the radial nerve is identified and protected throughout the operation. Dissection is carried down through the musculospiral groove usually between the extensor carpi radialis longus and the brachioradialis and the radial fragment is exposed subperiosteally for a distance of at least 12 inches. Scar tissue and deviated bone fragments are removed from the site of union. The ends of both radial fragments are sawed back at right angles to the shaft until the sclerotic portion has been removed and good vascular bone is apparent. The graft is held in place by metallic fixation. In 15 cases, the distal fragment is so osteoperforated that screws will not hold and in these cases a distal strand of No. 22 tantalum wire has been used.

In this series infection occurred in 2 cases. In one case the purulent drainage had to be continued for 2 weeks after the operation, and in the other case it occurred 8 weeks postoperatively. Penicillin is given 100,000 units for 3 days before operation and both penicillin and sulfadiazine are given for at least 6 or 7 days after operation.

C. FRED GOEDENOW, M.D.

Tendinous Recombination of the Hand Following Irreparable Injury to the Peripheral Nerves and Brachial Plexus. C. A. Lockey and S. R. McPherson. *J Bone & Jt Surg* 1947; 29:570.

Combinations have produced many interesting injuries to nerves of the upper extremity and the hand, as the brachial plexus and the ulnar nerve, and the results have been variable.

Restoration of function of the hand after such injuries is often difficult. At times it is possible to be restored in case of loss of function of the hand by transfer of muscle by transfer of a nerve.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

A Study of the Results of the Surgical Treatment of Varicose Veins. Ross S. McIlwhee Jr., and Bernard Malsel. *Ann Surg* 1947 126 350

The authors have reviewed all of the cases of varicose veins treated by operation at the New York Hospital New York City between 1920 and 1944. They desired to obtain information concerning the physical findings, the operation employed, the duration of hospitalization, the number of postoperative injections required to give satisfactory result and the ultimate outcome.

As indicated by the authors among many competent and experienced surgeons there seems to be no general agreement on the operation offering the best chance of a cure in so common a disorder a variety of operative procedures are rarely to be found in the current reports. The authors point out that the lack of proof that there is any one method which is superior to others in treatment of varicose veins is demonstrated by the simultaneous use of several operative procedures by the surgeons on the three services of the New York Hospital men with the same relative ability and experience. Each service employed one of the three more common operative procedures: (1) high saphenous ligation (2) multiple ligation (3) stripping the vein without regard to the events of the varicosities.

The operations were carried out under local anesthesia and consisted of five types of procedure: (1) high ligation of the internal saphenous vein at its junction with the femoral vein care being taken to divide all collateral and remove a segment of vein (2) procedure No. 1 plus multiple interruption of ligation and division of the vein along its course (3) procedure No. 1 plus extirpation of a portion of the vein by means of a May trapper (4) procedure No. 1 plus retrograde injection of a sclerosing solution into the distal vein and (5) procedure No. 1 plus excision of prominent varicosities which were thigh or calf.

Results in 452 cases of varicose vein surgery during 1 year or more after operation were recorded. High ligation of the saphenous vein combined with multiple ligation or retrograde injection or stripping of the vein have been found to give satisfactory results in between 80 and 90 per cent of the cases. If ligation was longest and the degree of discomfort was greatest following retrograde injection or stripping and was least following high ligation or multiple ligation.

Complications were more frequent after multiple ligation though the majority were not serious. They occurred more often after retrograde injection than after high ligation or stripping. They were also more frequent after stripping than after high ligation or multiple ligation.

grade injection required the smallest number of postoperative sclerosing solution injections to attain satisfactory results.

The authors conclude that multiple ligation (including of course high ligation of the saphenous vein) is the operation of choice.

EDWARD L. LEWISON, M.D.

The Effects on Venous Endothelium of Alterations in Blood Flow Through the Vessels in Vein Walls, and the Possible Relation to Thrombosis. James F. O'Neill. *Ann Surg* 1941 126 250

At the suggestion of Cecil A. Drinker the author undertook the study of spontaneous thrombophlebitis or phlebotrombosis by observing the nutrition of vein walls in specially prepared flat histologic preparations.

Relevant to the etiology of the clinical menace of venous thrombosis the author presupposes that an imbalance between any two of the following factors must exist. These factors are: (a) alteration in the quality or quantity of blood constituents (b) alterations in the rate of flow of blood in the veins and (c) alterations in the endothelial coats of the veins. This paper is devoted principally to a consideration of the last named factor, the vein walls and some of their physiologic relationships.

Venous thrombosis can be produced experimentally by damaging the vein wall in many various ways. This hardly resembles any known pathologic process which may occur in postoperative or postpartum patients or in individuals afflicted with systemic infection, cardiovascular disease or in other debilitating disorders wherein venous thromboses may occur.

Since few investigators have studied the vascular supply to vein walls the author was virtually a pioneer in developing a most ingenious technique for the histologic preparation of flat vein wall segments. The preparation so made allows for careful examination of the vasa venarum and a more exact anatomic description of blood vessel patterns in vein wall. Dilute silver nitrate solution used in staining and studying the inner coats of the vein walls and a benzidine stain is used for outlining the vascular plexus in the vein walls.

Carefully devised experiments were performed to study the effect on the vein wall, principally on the endothelium when the blood supply via the vasa venarum was cut off. Circulation indicated that division of all blood vessels lymphatics and nerves to a given vein segment over a period of one to six hours resulted in increased permeability and edema. This occurred with the preservation of the endothelial part of the wall but the endothelial cells were

EDWARD L. LEWISON, M.D.

fractures, i.e., open reduction and circular wire loop fixation had not been very satisfactory. The post-operative disability lasted for an average of 164 days. Exact apposition of the patellar fragments was rarely possible and the lack of a smoothly gliding even, articular surface gave rise to traumatic arthritis and to permanent limitation of flexion and extension of the knee joint.

Brooke suggested that the patella was not a real element of bone since it developed in tendon and the tendon, but a rudimentary third bone of the leg. He found the patella to be absent in a great number of fast moving animals and concluded that it was not necessary for normal human locomotion. Although very interesting, these observations are of lesser importance in the evaluation of whether or not patellectomy is a good procedure than clinical observations of operated patients.

Schmir pointed out that patellectomy was a short procedure of which the convalescent period was very brief (about 8 weeks) and that it did not decrease the range of motion or stability of the knee.

A more precise analysis of these 3 points showed however that the excision of the patella actually was a rather simple procedure although the repair of the created defect often was difficult and time consuming. Watson Jones recommended an overlapping "bunched" type of repair while MacAusland used fascial strips to repair the defect and Brooke used silk and cotton sutures. Early mobilization of the knee joint does not depend on the type of operation but rather on an intact extensor apparatus of the leg; therefore no objection to mobilizing the knee actively shortly after suture of the fractured patellar fragments. It must also be taken into consideration that the question as to whether or not the results of patellectomy were excellent were not alike in the literature. Bruce, Walmsley and Chou observed that patellectomy in dogs and rabbit eventually caused degenerative arthritis and limitation of motion in the knee joint.

Haxton proved that the patella played an important part in the extension of the leg against resistance. Although the quadriceps of the patellectomized leg did not show any atrophy dynamometric measurements showed a definite weakness compared with the normal extremity. (Quoted from that the re was a loss of strength. The

regeneration of an imperfectly formed, telluric structure of the formation of the knee interfered with the normal function of a tomized knee. Also in the absence of a femoral condyles were entirely correct as to repeated trauma.

Excision of the patella was found to be a comminuted fracture of the bone in case of the suture holding the fractured fragments together and necessitating another operation in which a patellar osteophyte limited motion of the knee joint. Partial patellectomy was done in which the absence of the excised part would not disturb the articulating surface of the tibia. Tanner reported a number of patients in 1911.

The discussion of this paper was continued. He suggested that the wire loop fixation of a transverse fracture of the patella was the method of choice and stated that when it was carried out with care it showed consistently good results. In fact, Somerville had the operation performed with very satisfactory results.

Borrie found that patients treated with wire fixation and who were allowed up for a few days of time eventually showed compensatory arthritis and irregularities of the patella. He reduced the range of flexion in the knee joint. These patients often had to be reoperated on a few days later when performed.

Levinson had excellent results from the use of his teacher Valla. After exact reduction of the patella the fragments were held together by wire hooks which were removed after the lateral ligaments were sutured together with catgut. Motion started after the eighth day. He thought that the absence of a foreign body (wire) favored the end result.

McClary favored the wire loop type of repair for transverse fractures of the patella combined with comminution of the peripatellar fibrous structure.

Mr. McCallum in his closing remarks expressed a feeling that most of the speakers favored the conservative point of view. He agreed with the speakers occasionally the results of the conservative method were not perfect. He felt that the use of a wire loop fixation of the patella was a better method than the use of a wire loop.

certain unless the actual communication are either ligated, extirpated or thrombosed. Of the 3 patients whose cases were reported in the literature and who were treated surgically, only 13 were cured. In 6 instances a direct attack on the involved vessels with excision was successful. Four patients were cured by ligation and division of multiple small fistulas. Only 1 of the cures was effected by ligation of the principal artery leading toward the involved vessels. Reid and McGuire reported a cure of congenital fistula between the external carotid artery and the external jugular vein in which case the artery and vein were ligated and transected the proximal vein then being twisted to occlude the fistula. Ferris Smith reported the cure of an aneurysm in the tympanum in which he ligated the veins and packed the aneurysm.

In 12 of the cases reported in the literature the patient required more than 1 operation to relieve the symptoms partially or totally. In the case presented considerable improvement resulted after 1 operation. The patient was a 6 year old girl who had noted buzzing in her left ear as long as she could remember. There was a swelling below the ear and a pronounced thrill could be felt over the involved area. The murmur could be diminished by pressure over the left common carotid artery but pressure over both common carotid arteries was required to obliterate it. X rays revealed the left half of the mandible to be larger than the right. Angiography with 15 cc of thorotrast injected into the left common carotid artery revealed that the opaque medium went directly into the external artery, avoiding the internal carotid and then into the internal maxillary artery. Here abnormal arteriovenous communication between the latter artery and the vein of the pterygoid plexus could be seen. Since direct attack on the fistula would have involved a dissection and a figuring procedure and since compression of the common carotid arteries had been necessary to stop the murmur which indicated that some blood supply to the fistula was coming from the opposite side it was decided to pack the artery with muscle at the site of the fistula and thus directly occlude the abnormal communication.

At operation a very large pulsating external jugular vein was ligated and transected, then the branches of the external carotid artery proximal to the fistula were ligated and a 5 cm by 3 mm strip of sternomastoid muscle was inserted into the external carotid so as to extend into the area of the fistula. The postoperative course was uneventful and the patient was discharged on the eighth postoperative day. Two and a half months after operation a faint bruit could be heard just in front of the left ear and pressure over the external carotid artery stopped the murmur which indicated that this vessel was now supplying a small opening not occluded by the muscle. The size of the heart has diminished considerably since operation. The operative technique was followed a month after operation with a similar result and no recurrence of the murmur.

A summary of the cases of congenital arteriovenous fistulas of the face and neck reported in the literature is then presented. ROBERT A. NARATOFF, M.D.

Fatality following the Use of Intravenous Ether in the Treatment of Peripheral Vascular Disease
Sydney Sewall *Bull Hosp Joint Dis., N Y* 1947
8: 11.

The author presents a case in which death followed the use of ether intravenously in the treatment of peripheral vascular disease. Postmortem examination revealed numerous pulmonary fat emboli and parenchymatous degeneration of the liver and kidneys. A search of the literature showed that ether was found not to be as harmless as previously believed. In view of the findings the author suggests that cases be well selected before treatment by intravenous injection of ether is undertaken, that liver and renal functions be carefully determined before treatment that these tests be carried out at frequent intervals during the period of treatment and that treatment be immediately discontinued if any impairment of the function of the vital organs is found.

A history of the chemical production of ether is presented. The introduction of its use in medicine and its use for therapeutic purposes is described.

ether was first used intravenously in the treatment of peripheral vascular disease in 1945. Prior to its use intravenously, it was used intramuscularly, but the objection to this method was that ulcers developed at the site of injection. The mechanism of its action is thought to be due to the increased flow of blood in the peripheral vessels caused by the action of ether gas on the small peripheral collateral. In the treatment of peripheral vascular disease a 2 to 4 per cent solution in 1,000 c.c. of sixth molar lactate saline or glucose is given daily for 12 consecutive days. After a rest period of 2 days 12 more daily injections are given.

The author presents a case in which ether was used in the manner described. The patient was a 53 year old negro female who had an ulcerating arteriosclerosis of both lower extremities. Amputation of the fifth toe because of gangrene was followed by ulceration at the site of amputation. A 25 percent solution of ether and dextrose was given intravenously for 12 days. After a 2 day rest period treatments were again resumed. With this treatment the patient improved generally and locally. She experienced a sense of warmth in both lower extremities and a feeling of well being. Healthy granulation tissue began to appear in the wound. On the third day of the second course the patient developed a shaking chill followed by an elevated temperature. The treatment was stopped and on the morning of the second day after cessation of treatment the patient had a 10 centimeter examination of the liver was found to be extremely small and practically crumpled when handled. Microscopic examination of a biopsy specimen gave a picture of pure chrymatocytic hepatitis. The post mortem examination was revealing in that it showed the characteristic changes in the liver.

ing if the red corpuscles of the donor have been destroyed or are still present in the recipient's blood. The authors call this differential agglutination.

A case is described in which violent hemolytic reactions occurred after a series of transfusions. These reactions were explained by the presence in the patient a serum of an abnormal univalent isoantibody unrelated to groups A B O types M N or types Rh or Hr.

The blood factor has been given the provisional designation of SI. The agglutininogen has been found in the blood of 19 of 148 Caucasians tested and it seems to be inherited as a simple dominant mendelian factor.

THEODORE B. MAXWELL, M D

Peritoneal Irrigation for Acute Renal Damage following Incompatible Blood Transfusion: A Discussion Based on 3 Cases. E. E. Muirhead, A. B. Small, A. E. Haley and J. M. Hill. *J Lab Clin M.*, 1947 32 988.

The authors stated that peritoneal irrigation used for the treatment of patients suffering from renal insufficiency following incompatible blood transfusion clears substantial quantities of urea and presumably other waste products from the body. However they believe that the use of crystalloid solution for irrigation appears to be related to 2 major complications, namely the accentuation of acidosis and the absorption of water and salts from the peritoneum. These complications are considered to be deleterious to the progress of these patients during the phase of renal insufficiency and they may retard the onset of diuresis. Muirhead, Small, Haley and Hill have suggested a three-phase regime which seems to oppose these complications. They divided the clinical course of patients experiencing incompatible blood transfusions into (1) hemolysis and hypotension which are characterized by a sudden onset with apprehen-

sion, tightness in the chest, backache, dyspnea, cyanosis and mental confusion, hypotension, chills and fever and hemoglobinemia, hemoglobinuria. (2) renal insufficiency which is attended by oliguria, blood casts in the urine, hypertension, azotemia, altered chemical pattern of blood (mainly depressed serum sodium, calcium, blood chloride concentration and carbon dioxide combining power of plasma) and mounting antibody titer and (3) copious diuresis which is accompanied by marked water salt loss from the body. Each phase requires its own distinctive type of management.

During the first phase blood transfusion of undoubted compatibility should be given to cope with anemia and lowered blood volume, thus decreasing the period of hypotension.

During the second phase, forcing fluids appears deleterious because the kidneys are not in a position to handle water and salts. The best results during this period have been obtained by restricting the fluid intake to a conservative estimated insensible loss plus the scanty urinary output (a total usually of from 800 to 1,500 ml. daily for from 6 to 8 days). A high caloric low salt formula is given with this fluid plus water soluble vitamins. Sodium bicarbonate in doses of from 4 to 6 gm. is given daily to cope with an excessive lowering of the carbon dioxide combining power of the plasma. This regime is based on the premise that damaged kidneys require time for healing. When the diuresis appears the water salt loss through this means is replaced. Such losses may require from 20 to 40 gm. of salts daily plus from 5,000 to 10,000 ml. of water. As soon as possible the patient is allowed to adjust his own intake and output.

It has been the experience of the authors that when patients are overloaded with water and salt they die or the onset of diuresis is delayed.

ROBERT TURNER, M D

The author presents a brief review of the toxic effects of ether. He notes that Mann (5) in 1926 showed that ether produced demonstrable effects on hepatic activity. The capacity of the liver to store glycogen is also disturbed by ether. The liver under ordinary circumstances converts lactic acid to glycogen but during ether anesthesia it does not seem able to do this and the liver glycogen is depleted.

HENRY F. TUCKER, M.D.

Functional Survival of Autogenous and Homogenous Transplants of Blood Vessels. An Experimental Study. Carl S. Williamson and Frank C. Mann. *Arch. Surg.* 1927 54: 529.

A series of 6 medium-sized dogs were selected at random. This group of animals was divided into 3 pairs so that both an animal in each pair would act both as a donor and a recipient. With the animals under ether anesthesia and with the use of aseptic technique sections from the carotid artery and the jugular vein of each animal were removed and exchanged for similar sections removed from the same vessels of the other member of the pair.

Of the 12 transplants, 6 were arterial transplants and 6 arterial transplants resulted in no lumen after an elapsed time of 36 to 63 days. In the arterial transplant, no lumen will be developed until the time of removal, and the other lumen could not be determined grossly, but a limited degree of lumen was observed by histological examination. All the venous transplants had ceased to function at the time of removal and the remaining arterial transplants had also ceased to function. The results in 1 of the animal was compromised by a severe postoperative infection. Grossly there was nothing to account for the failure of the vascular transplant to survive. The histologic picture in both the arteries and the veins was well but was consistent in some respects in all the specimens.

The most common histologic picture in all thrombotic arteries is in the tendency toward vascularization in the thrombus which occluded the lumen of the vessel. The vascularization included the walls of the vessels themselves. These newly formed blood vessels were fairly large in some instances and were evidently serving as conduits for a small amount of blood in both the arterial and the venous transplants. The thrombi which were present in the arterial transplants had a poorer appearance, some of them but those in the veins were more well organized and there was a coiled tendency of the blood vessel into segments by cross-section.

The distribution of the arteries was less regular than the veins and there was a greater tendency toward canalization of the thrombi. In general, the arteries had a fairly well prepared lumen, but it has been largely determined that the lumen of the vessel is not the same as the lumen of the normal vessel in number and size of the blood vessels in the vessel itself.

fibers and much of the elastic tissue is replaced by fibrous tissue. In summary, it is shown that the structure of the arterial and the venous segments of vessels had not been damaged except in a few instances.

Uniformly the destructive process in the walls of the transplanted veins was complete. The veins were thrombosed and, while there was a tendency toward vascularization, the process was not pronounced. The thrombi were more solidly organized and seemed to be attached to the wall of the vein than to the arterial transplants. The venous segments were for the most part well preserved. There was extensive replacement of the normal structures with fibrous tissue and, therefore, this replacement was almost complete. Attention of the severity of the reaction in the veins was obvious. In all the transplants, the arterial transplants, there was a tendency toward vascularization of the walls of the vessels as well as of the thrombi which occluded the lumen. The character of the most pronounced in the arterial transplants was in the thrombi. This led by the time of the removal to be considerably different from the arterial circulation. The status of the transplants in relation to the ultimate survival of the transplants is a problem for future investigation.

The author emphasizes the following points: 1. The technique of vascular transplants is established and the surgeon who is able to perform the requirement necessary for success can expect satisfactory end results in the transplants. 2. The autogenous transplant method is a feasible surgical procedure in the light of present knowledge.

3. Homogenous transplants in the arteries as well as of other body structures are not in the light of present knowledge.

4. There is a striking tendency for thrombi to develop in both the thrombus and the wall of the vessel in homogenous vascular transplants. This is the most conspicuous in the arterial transplants.

BLOOD TRANSFUSION

Hemolytic Intra-group Transfusion Reaction Due to a Hemagglutinating not Hitherto Described (Reaction) in the Blood of Guinea Pigs. Due to A. B. Bernard and J. G. J. van der Vliet. *Arch. Intern. Med.* 1927 53: 3.

Although a percentage of intra-group reactions is avoided by testing for the Rh factor, it is still a question whether a child or an adult is Rh positive or Rh negative and hemolytic or non-hemolytic due to other non-specific agents. These reactions themselves are of a gradual set in after hemolytic reaction. The reaction is not a usual one and is not after hemolytic reaction. It is a rather available laboratory test for diagnosis of the blood group.

ing if the red corpuscles of the donor have been destroyed or are still present in the recipient's blood. The authors call this differential agglutination.

A case is described in which violent hemolytic reactions occurred after a series of transfusions. These reactions were explained by the presence in the patient's serum of an abnormal univalent isoantibody unrelated to groups A, B, O, types M, N or types Rh or Hr.

The blood factor has been given the provisional designation of SL. The agglutininogen has been found in the blood of 19 of 148 Caucasians tested and it seems to be inherited as a simple dominant mendelian factor.

THEODORE B. MARSHALL, M.D.

Peritoneal Irrigation for Acute Renal Damage Following Incompatible Blood Transfusion: A Discussion Based on 3 Cases. E. E. Muirhead, A. B. Small, A. E. Haley and J. M. Hill. *J. Lab. Clin. Med.*, 1947, 32, 983.

The authors stated that peritoneal irrigation used for the treatment of patients suffering from renal insufficiency following incompatible blood transfusion clears substantial quantities of urea and presumably other waste products from the body. However they believe that the use of crystalloid solution for irrigation appears to be related to 2 major complications, namely the accentuation of acidosis and the absorption of water and salts from the peritoneum. These complications are considered to be deleterious to the progress of these patients during the phase of renal insufficiency and they may retard the onset of diuresis. Muirhead, Small, Haley and Hill have suggested a "three-phase" regime which seems to oppose these complications. They divided the clinical course of patients experiencing incompatible blood transfusions into (1) hemolysis and hypotension which are characterized by a sudden onset with apprehen-

sion, tightness in the chest, backache, dyspnea, cyanosis and mental confusion, hypotension, chills and fever and hemoglobinemia-hemoglobinuria; (2) renal insufficiency which is attended by oliguria, blood casts in the urine, hypertension, azotemia, altered chemical pattern of blood (mainly depressed serum sodium, calcium, blood chloride concentration and carbon dioxide combining power of plasma) and mounting antibody titer and (3) copious diuresis which is accompanied by marked water salt loss from the body. Each phase requires its own distinctive type of management.

During the first phase blood transfusion of undoubted compatibility should be given to cope with anemia and lowered blood volume thus decreasing the period of hypotension.

During the second phase, forcing fluids appears deleterious because the kidneys are not in a position to handle water and salts. The best results during this period have been obtained by restricting the fluid intake to a conservative estimated insensible loss plus the scanty urinary output (a total usually of from 800 to 1,500 ml. daily for from 6 to 8 days). A high caloric, low salt formula is given with this fluid plus water soluble vitamins. Sodium bicarbonate in doses of from 4 to 6 gm. is given daily to cope with an excessive lowering of the carbon dioxide combining power of the plasma. This regime is based on the premise that damaged kidneys require time for healing. When the diuresis appears the water salt loss through this means is replaced. Such losses may require from 20 to 40 gm. of salts daily plus from 5,000 to 10,000 ml. of water. As soon as possible the patient is allowed to adjust his own intake and output.

It has been the experience of the authors that when patients are overloaded with water and salt they die or the onset of diuresis is delayed.

ROBERT TITCHELL, M.D.

SURGICAL TECHNIQUE

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Bone Abscess from Human Bite A. T. Andreasen.
Fed J S 1 191 34 4 1

The author reports a case of bone abscess arising from a human bite. This is the only case in the literature. A 21 year old army officer was bitten at the base of the right index finger by an enemy soldier. The bone was exposed and the soft parts were badly torn. The wound became badly infected but healed in 2 weeks with good return of function. However the patient was troubled with a highly tender painful swelling over the palmar aspect of the metacarpal bone.

Several weeks later the wound area began to swell and became more inflamed. It became red and swollen. There was considerable edema of the dorsum of the hand. An abscess and marked tenderness over the metacarpal head appeared. After drainage the wound rapidly healed. The organisms were hemolytic staphylococci and fusiform bacilli of the type seen in Vincent's angina.

Some weeks later a diffuse swelling of the same region appeared and the patient complained of aching. A fluctuant swelling was noted. On x-ray examination a clear area of abscess with considerable periosteal reaction about them were seen in the heads of the second and third metacarpals. The hand was immobilized in plaster for 2 months to allow the swelling to subside.

After preoperative ulnar and brachial plexus block anesthesia an incision was made along the radial wrist of the dorsal aspect of the second metacarpal from 1 cm. above the metacarpophalangeal joint to 1 cm. proximal to the base of the bone. The superficial fascia was incised in the line of the incision. The incision through the deep fascia was so placed as to leave the compartment containing the tendons intact. The incision was then carried down to bone through the periosteum on the radial edge of the 2nd metacarpal. The periosteum was elevated. With a fine matrigue the abscess was exposed. After a check was made with a methylene blue test the abscess was opened carefully. The abscess was then drained. The periosteum was sutured over the bone. The skin was sutured in the hair placed on a wet paper to replace the lost finger in position. At the metacarpophalangeal joint the wound was closed by primary union. There was only slight residual swelling. The bone abscess and the abscess of the soft parts were cured.

Apparently the abscess deepened in the first few weeks after the bite. There was a local abscess formation which was drained. The abscess was treated with a 1% solution of the unexcavated bone. The abscess opened again several times but did not recur.

The author recommends the deep edge of the incision in approaching the second metacarpal. A good access and does not disturb the flexor tendons around the extensor tendons. He points out that superficial fascia often may consist of a firm. Recognition of this is important to avoid unnecessary stripping up of the wrong fascial layer.

An arrangement is described by which a drain can be taken during the operation procedure. It is of value in a hand and forearm. It is of value in a joint space.

The author uses a wooden block beneath the surface of the hand during surgery to support the hand.

Meticulous asepsis is well worth the additional care required.

Rehabilitation has been largely responsible for better functional results following the treatment of hand injuries and infections.

ROBERT R. DUNN, M.D.

Caronamide and Penicillin. J. William Orsow, William P. Dodge, Carl Joseph C. Orsow and A. Katharine Miller. J. Am. Med. Ass. 1943 133 13

The authors studied a new drug, caronamide (4-carboxyphenylmethanesulfonamide) when administered by mouth to patients receiving penicillin. Caronamide produces a physiological and biochemical inhibition of the excretion of this antibiotic. In elevation of the concentration of penicillin in plasma. With the aid of caronamide it is possible to maintain a high plasma concentration of penicillin in the treatment of resistant infections.

Normally about 80 per cent of penicillin in urine is excreted by the renal tubules and is maintained 20 per cent by glomerular filtration. It has been known that penicillin and para-aminobenzoic acid which are excreted by the renal tubules inhibit the excretion of penicillin. These drugs act on the active transport mechanism of the renal tubules and thus inhibit the excretion of penicillin. Caronamide on the basis of chemical structure is found to be capable of producing a marked inhibition of penicillin excretion. The effectiveness of this drug depends on its competitive inhibition of penicillin excretion. The tubules and a causal relationship is shown by that transport mechanism.

In this low test in a patient receiving penicillin while receiving caronamide the excretion of penicillin was increased. The excretion of penicillin was increased by the administration of caronamide. The excretion of penicillin was increased by the administration of caronamide. The excretion of penicillin was increased by the administration of caronamide.

to 7 times those observed during the control periods. Buffering agents were not administered with the penicillin, the patients were allowed to take fluids freely, meals were given in accordance with hospital routine and no effort was made to enhance the penicillin levels apart from the administration of caronamide.

Another group of 8 patients were given penicillin intramuscularly and caronamide orally in varying dosages. Five of these patients given either 1 gm. of caronamide every 3 hours or 2 gm. every 4 hours showed an increase of the penicillin plasma levels of from 2 to 7 times those observed during the control periods. Three patients given only 1 gm. of caronamide every 2 hours failed to show the same degree of increase of penicillin concentrations.

Six patients receiving penicillin in beeswax and oil (Romanovsky formula) and oral caronamide also showed an increase in penicillin plasma concentrations while 3 other patients yielded equivocal results. This phase of the investigation has thus far been incompletely studied.

This clinical investigation suggests that from two-fold to sevenfold increase of penicillin plasma concentration may be expected if about 2 gm. of caronamide are administered concomitantly with penicillin (given orally or parenterally) every 3 and 4 hours respectively. Thus far no systemic toxicity was noted in the patients who received caronamide. This drug promises great therapeutic usefulness in the treatment of lesions which require high penicillin concentrations.

ROBERT TUKELL, M.D.

Anuria Observed in Connection with Penicillin Therapy

Bengt Nylen *Acta chir scand* 1947
95 483

Reports in the literature on toxic reactions in penicillin therapy with special regard to the kidneys are reviewed and the author presents a case of anuria which probably resulted from toxic effects of penicillin on the kidneys. In an experimental investigation on rats he found that the penicillin used had no diuresis inhibiting effect on animals with damaged kidneys.

Minor transient rises of the nonprotein nitrogen have been reported in penicillin therapy but albuminuria or other signs of renal damage were lacking. It has been found that penicillin is excreted for the most part through the tubules. When renal function is impaired penicillin is excreted more slowly and to a lesser extent and the penicillin level in the blood is higher than in normal cases. Anuria has been reported in a case of acute meningitis treated with sulfamerazine and penicillin and has been produced experimentally in rabbits by the injection of large doses of penicillin. The reactions observed in penicillin therapy are generally attributed to impurities in the penicillin.

In order to determine whether penicillin, in the case of damaged kidneys, has any effect on diuresis the following experiment was performed. The left kidney was removed from a group of male rats and 3

weeks later the upper and lower poles of the right kidney were removed. Control animals were killed immediately after the second operation and the remainder of the kidneys was removed and weighed for comparison with the amount of renal substance in the experimental animals. After about 1 month the experimental animals were placed in cages where the urine could be collected, measured and tested for albumin daily. Water intake and weight were also recorded. These animals were then divided into two groups, one group of which received daily intramuscular injections of penicillin in 6 divided doses for 4 days. Six days later the animals were killed and the kidneys were weighed and prepared for histologic examination. Urea nitrogen determinations were made before, during and after the test.

In these tests the experimental animals showed no difference from the controls in regard to the amount of urine after the injection of penicillin for 4 days nor was there any observable difference between the experimental animals and controls with regard to weight, albumin reaction, urea nitrogen and histologic examination. According to this experiment it seems that penicillin injection in rats whose kidneys have been damaged causes no inhibitory effect on diuresis. The purity of the penicillin used in the experiments was about 1,300 Oxford units per mgm. This penicillin was considerably purer than the penicillin used in the clinical case. The purity of the penicillin may account for the negative result in the experimental test.

JOHN L. LINQVIST, M.D.

ANESTHESIA

Spinal Fluid Findings in Spinal Anesthesia. M. Gene Black. *Anesthesiology* 1947 8 382

A study of the spinal fluid in 200 patients was made to determine the effect of spinal anesthesia. The controls consisted of 75 patients who had no previous record of spinal anesthesia. The spinal fluids taken preoperatively were within normal limits. In 60 cases in which the fluid was taken from 30 days to 10 years after the spinal anesthesia, there was in comparison a mild increase in protein chiefly because the interval was less than 3 months in 30 cases. In 25 cases specimens of spinal fluid obtained before and after continuous spinal anesthesia were examined. Protein variations were negligible which suggests that the time interval was inadequate for meningeal or tissue irritation to be demonstrated. The spinal fluid sugar in this group presents a marked rise at the end of operation when the patient was kept in the horizontal position.

Pontocaine and glucose were the agents used in this study. It is thought probable that the rise in spinal fluid sugar was caused by pooling of the glucose at the site of injection. The Trendelenburg position promotes diffusion and it is believed that diffused glucose promotes the metabolism of the central nervous system.

It is suggested that pontocaine or any similar anesthetic agent used intraspinally may produce

transient irritation in the possible exception occurring in the rare individual who is allergic to the drug (glucose when used in conjunction with spinal anesthetic agents and if permitted to diffuse by use of the Trendelenburg position may be helpful rather than harmful to the function of the central nervous system.

MARY FRANCES FORBES

Discussion on Further Experiences with Curare
Frederick Prescott, Geoffrey Organe, Barnett
Mallinson, John Gillies and Others. *F&R*
Dec 31, Lond., 1947 40-593.

FREDERICK PRESCOTT gives us a picture of the clinical pharmacology of curare. Curare is a crude material totally unfit for clinical use. Clinically the only alkaloid preparation that resists the tubocurarine chloride. In clinical uses this drug has no action other than that of paralyzing skeletal muscle by blocking conduction at the myoneural junction.

Ditubocurarine chloride belongs to the quaternary ammonium salt compound. In man the muscles are affected after curarization in the order of their phylogeny, i.e. muscles supplied by the cranial nerves first, then those of the limbs, back, abdomen, intercostal region, and finally those of the diaphragm.

Epinephrine is said to potentiate the action of prostigmine, which is the antagonist of curarizing drugs. Its effect has not been confirmed in man. It is necessary to give atropine when prostigmine is used to prevent the stimulation of curarization on the parasympathetic nervous system.

Curarelike drugs form a block at the myoneural junction possibly by combining with the receptor substance in the muscle. They do not interfere with the product of L-acetylcholine.

Experimentally the view now held that curariform drugs act in the same way as acetylcholine, i.e. as a chemical mediator.

The curariform action of ether was noted a far back as 1804, but that in high blood concentration has the same effect.

The experimental work of Smith and others has shown that ditubocurarine is a significant central stimulant, depressant, or analgesic, etc. in man. Collins found that the total ionization dose of ditubocurarine is 0.5 mg per kg body weight.

It is curariform in its action on the ear, larynx, and trachea.

Collins and Higgs describe the form of the heart muscle which lies in the trachea in the case of curariform drugs. They state that the heart is a very sensitive organ and that the use of ditubocurarine as a drug is small.

Collins and Cullen believe that ditubocurarine causes relaxation of the smooth muscle of the small intestine but that it does not appear to be contracted. It is a useful agent for the treatment of the small intestine.

The fact that ditubocurarine is a paralytic agent is well known.

low a limitation is an intravenous injection of a satisfactory and this fact has been confirmed by a volunteer.

Both of these drugs produce salivation. For this reason patients should be intubated before using ditubocurarine or intubation.

GEORGE ORGANE describes his experience with ditubocurarine. Case records were shown showing that the results of using ditubocurarine in these cases are not always all that could be desired. The author and Prescott did the first experiments on the preparation known as tubarine at 1942. He believes that although it is useful in the early clinical report, it is not without its drawbacks. Among the 86 patients but only abdominal operations there were 24 with major and 15 with minor chest complications. All are competent and techniques were involved in the first complications. One patient died of bronchopneumonia, 1 of the original disease and 1 was later to have bronchiectasis. The others appeared to have recovered at the time of their discharge but not delayed in any case.

Tubarine has been valuable in the relief of dyspnea, but does not always prevent it. Case reports are presented.

Organe believes that tubarine is a valuable agent in bronchoscopy and esophagoscopy, while it is true that alone they are dangerous procedures because of the difficulty of maintaining a clear airway. If tubarine is used the airway remains clear. His patient breathes quietly. A respiratory is a common accompaniment of severe dyspnea, but the anesthetic agent, but if much less common, if tubarine is used. This author has his own experience emphasizing that one must not neglect none of the precautions in using tubarine.

BARNETT MALLINSON gives some general aspects of the technique of curarization. One of the most significant aspects of the advent of curarization is that it can reduce the number of spinal anesthetic administrations. Curare can be given in the first place or sometimes in the first place with a general anesthetic first place anesthetic usually a general anesthetic can be of a lighter plane. There is no danger of the first place anesthetic.

The author has found the use of curare as a pre-anesthetic that for laryngeal intubation is very useful and prevents the usual large doses of ether or chloroform under a very comfortable condition.

A. C. JONES describes Curare as a useful agent in the treatment of the small intestine. The author believes that curare is a useful agent in the treatment of the small intestine, but if the curarization is sufficient, it is not a useful agent in the treatment of the small intestine. In this case, the author is not sure of the results of the treatment of the small intestine.

JOHN GILLIES. The use of curare in the treatment of the small intestine is well known. It is a useful agent in the treatment of the small intestine, but if the curarization is sufficient, it is not a useful agent in the treatment of the small intestine.

JOHN HALTON People who use curare must learn that it is not enough that the patient is just breathing. The respiration must be aided from the moment of the injection until the curare effect has passed off.

L. C. MOUNTFORD expresses the opinion that the larynx and trachea should be cannalized prior to the use of either curare or pentothal for intubating the trachea.

H. B. WILSON discussed a series of cases in which myanesthesia was used.

MASSEY DAWKINS In a series of 300 patients anesthetized with curare the mortality rate was about 12 times greater than that following the use of chloroform.

CECIL GRAY The 3 main dangers of tubocurarine appear to be its use by the inexperienced and the occurrence of regurgitation of the stomach contents. There is an insidious flowback of the stomach contents due to the abdominal relaxation of the esophageal muscle and sphincter. EDITH EASON M.D.

Resuscitation of the Heart in Anesthetic Syncope
(A propos de la ranimation du coeur dans les syncope anesthésiques) R. Desmarest, J. Lhermitte and G. Jacquot. *Anesthésie Par* 1939, 5: 481.

The authors discuss in great detail a case of anesthetic syncope which occurred at the final stage of a hysterectomy performed under nitrous oxide anesthesia. After artificial respiration and the intracardial injection of adrenalin had been unsuccessful the surgeon severed the sutures of the abdominal wall and performed massage of the heart from the abdominal cavity through the diaphragm. Five minutes after the beginning of the massage the heart started contracting again, and a little later spontaneous respiration set in. Only much later the pupils which had been in maximal dilatation came back to normal. The patient died 64 hours after the accident without having regained consciousness.

During these 2 1/2 days the patient developed signs of severe cerebral irritation: general tetanic convulsions which occurred every 30 to 40 minutes; hyperpyrexia, the positive Babinski sign and hypertension of 200 mm.

The histologic examination of the brain revealed extreme damage caused by anoxia during the arrest of the circulation. The foremost finding was widespread lipid degeneration. This degeneration involved practically every cell of the cerebral cortex also the endothelium of the blood vessels in this region and the adventitia of the precapillaries showed numerous lipid droplets. In the striate body and in the cerebellum the lipid degeneration was less marked whereas the white matter and the gray cells of the medulla did not show any trace of lipid degeneration.

Slides stained according to Nissl revealed karyolysis in the pyramidal cells, hyaline degeneration, fibrillolysis, chromolysis and other degenerative signs which are described in great detail. The neuroglia, especially in the frontal lobe presented signs of proliferation and hyperplasia.

A review of the literature shows that about 100 cases are on record in which massage of the heart was done in anesthesia accidents. In 25 it was successful. Several of these cases showed the same course as the present case: survival for 2 or 3 days after the successful massage of the heart and death under the signs of severe brain damage. On the other hand there were cases reported in which heart action and respiration had stopped for as much as 15 minutes before heart massage was successful without leaving any signs whatever of brain damage.

The authors attach special prognostic importance to the condition of the pupils. They believe that total mydriasis of longer duration is a sign of damage done to the ciliospinal center which gives a poor prognosis even when the circulation and respiration have been restored. WERNER M. SOLMITS M.D.

PHYSICO-CHEMICAL METHODS IN SURGERY

ROENTGEOLOGY

Radiologic Survey of the Salivary Glands (Estado radiológico de las glándulas salivares) Raúl Leborgne, M.D. (Luzern 1924) 535

The radiograph of the salivary gland is done with plain roentgenism and by the latter with the injection of an opaque medium. The roentgenogram of the parotid gland and a series of small nodules is necessary to use with the opaque medium. The lateral roentgenogram of the parotid gland is three fourths of the whole. The lateral roentgenogram of the parotid gland is three fourths of the whole. The lateral roentgenogram of the parotid gland is three fourths of the whole.

The anterior view of the parotid gland is the most useful. The anterior view of the parotid gland is the most useful. The anterior view of the parotid gland is the most useful.

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the gland. The opaque medium is in the gland for several days.

Cystic basilar adenitis and metastatic carcinoma similar to mixed tumors. Carcinoma produces stenosis of the salivary ducts. The parotid gland is the most useful.

FRANK P. FORTNUM, M.D.

The Technique of Direct (Percutaneous) Contrast Angiography E. Lindgren, Prof. J. J. 1924

The technique of direct needle puncture of the carotid artery for central angiography compared with the open operation method. The former is considered as the more reliable.

The opaque media used by the author are the first injection is 35 per cent iodine solution. The second injection is 50 per cent iodine solution. The third injection is 50 per cent iodine solution.

The puncture is made under 1 per cent ether anesthesia with the patient supine. The puncture is made under 1 per cent ether anesthesia with the patient supine.

The author avoids puncturing the common carotid artery because of the greater dilution of the dye shadows of the external carotid artery.

It will strike the internal carotid artery preferred. Between internal carotid and external carotid arteries.

It causes a burning or smart sensation in the jaw and around the ear. The patient is in a sitting position.

Once the puncture is made the contrast medium is injected. The patient is in a sitting position.

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castets can be changed showing the capillary and venous systems respectively. The roentgen tube is adjusted to the other position, a second injection is made, and three more films are exposed as described. This system was employed in 153 cases and only 4 unsuccessful examinations resulted.

ARTHUR W. PAYNE, M.D.
LEO G. RIGLER and THOMAS B. MERNER
Am J Roent 1947 58 367

Planigraphy in the Diagnosis of Bronchogenic Carcinoma. Recent publications show that bronchogenic carcinoma is increasing in frequency both absolutely and in proportion to other types of malignant neoplasms.

Among the various methods used for diagnosis bronchoscopy occupies first place especially since it provides a means of biopsy. The poor condition of the patient, however, sometimes prevents its use. In other instances especially when the carcinoma is localized to the upper lobe bronchi or when there is a distortion of the bronchi due to extrinsic lesions bronchoscopy is disappointing.

Great progress has been made lately in the roentgen study of the bronchogenic carcinoma. The diagnostic signs may be the result of secondary manifestations of carcinoma or of the primary appearance of the lesion.

The secondary manifestations are due to a gradual obstruction of the bronchial lumen by the carcinoma. Westermarck described three stages in the development of the obstruction. In the first stage there is diminished air content of the segment of the lung involved because of diminished intra alveolar pressure and hyperemia. In the second stage the increasing mass produces a check valve effect resulting in complete obstruction and atelectasis. Fluoroscopy and roentgenograms taken in the maximum of expiration and inspiration, will help most in demonstrating the various phases of the obstruction.

The primary signs of the carcinoma are a mass either in the hilar region or less commonly in the periphery a localized infiltrative process or a diffusion into the affected bronchi of definite value in further identifying the process. With the exception of bronchoscopy it is the most useful method of examination. There are however certain contraindications most important of which are severe dyspnea fever toxicity and uncontrollable cough.

Planigraphy which is also called tomography or laminaography is a more recent method for the diagnosis of bronchogenic carcinoma. It consists of a special attachment to the roentgen tube which holds the roentgen tube to move in opposite directions in one plane around a point of rotation which represents the desired depth. A trial exposure is made usually at about 10 cm. from the table top with the patient in supine position. Additional films are taken at 8 and 12 cm. from the table top and so

on until the clearest image of the lesion has been obtained. It is also advisable to make a film 1 cm. anterior and another film 1 cm. posterior to the level giving the most information about the lesion. In order to obtain parallel plane films in some instances it will be necessary to make the exposures in lateral or oblique views in respect to the patient's body.

Important planigraphic signs are the demonstration of an actual defect within the bronchus the visualization of the bronchus resembling a 'rat tail' and the showing of collateral evidence afforded by the secondary lung changes. For example a clear cut intrabronchial mass is more indicative of benign adenoma of the bronchus whereas if there is a rat tail deformity with surrounding infiltration or a telescopic carcinoma must be suspected.

Planigraphy serves as a supplement to or as a substitute for bronchoscopy. It is not intended however to replace the older methods of examination.

The authors used planigraphy in 181 patients suspected of pulmonary disease. Bronchial tumors were found to be present in 47 patients and in 10 of these a diagnosis of benign adenoma was made. The remaining 37 tumors were bronchial carcinomas as indicated by the collateral findings. Failures were noted in only 5 cases.

The authors present the planigrams with corresponding diagrams in several illustrative cases. The conclusion is reached that the accuracy of planigraphy compares favorably with other roentgen methods of examination and if the technique of application continues to improve it may even reduce the importance of some of the methods now in use.

T. LEVOTTA, M.D.
On Spontaneous Chronic Intestinal Invagination in Adults. P. Bjerre Hansen. *Acta radiol* Stockh. 1947 18 115

Although the occurrence of spontaneous intussusception of the intestine has often been described in children, it seldom has been described in adults. Diagnosis in most instances has been made by means of a barium enema. However the author describes 3 cases of intussusception in which the diagnosis was made by means of a contrast enema and barium meal. Although this procedure is not a new one, the author believes it has not been used frequently enough.

Pertinent roentgen findings may be divided into two groups those visualized by means of a contrast enema and those visualized by means of an oral barium meal.

1. The enema film reveals
2. Abrupt, smooth stop of the barium.
3. Bicornate configuration
4. Partial filling of the invagination sheath in ring shaped stripes, corresponding to the haustra, across the intussusceptum
5. Filling of the colon but with a central stripe like clearing



Fig. 1 (H. von) Distinct invagination is seen just at the flexure of the sigmoid both in the anteroposterior and the lateral views. The invagination is not palpable. The patient is a 45-year-old woman.

Fig. 2 (H. von) Distal part of the sigmoid colon.

The Roentgenologic Diagnosis of Appendical Calculi
 (Benjamin F. Lyon and L. M. F. in Bernburg
Radiology 1931 25 123)

This article is based on 100 cases collected from the literature and 10 personal cases. The latter are briefly described and illustrated with roentgenograms. The usual roentgen signs in 10 of the 10 cases of invagination was diagnosed from the roentgenograms and in 7 patients were operated on. The diagnosis was verified.

A review of the available literature leads to the following fact:

Incidence. Some estimates are given of appendical calculi occurrences. On the other hand, Stern and others consider and to cause appendicitis. The author 10 cases were estimated a total of 300 appendicitis cases.

Findings. There is no fault in the literature as to the effect that appendical calculi are found in the ileocecal junction. According to Kell and others, who offer the most plausible theory of the return of the feculent contents from the appendix, it occurs in invagination in patients of advanced age. This in turn causes a low grade catarrh of inflammation with its attendant secretion of inorganic salts, not in the mucosa are deposited on the surface of the invaginated part of the appendix. The process in invagination is not in the calculi. There is a small percentage with an incidence of 10 percent in patients.

Clinical signs. Of 60 patients who were operated on, 47 were males and 13 were females. There is no characteristic clinical symptom of invagination of the appendix.

Prognosis. The diagnosis of invagination of the appendix is not a rare occurrence. When the diagnosis is made, the patient should be operated on.

Treatment Immediate surgical intervention is indicated in all cases. Of 36 cases in which the outcome was mentioned 4 terminated fatally and 6 had a stormy course but recovery took place.

T. LECUTIA, M.D.

Diagnosis of Ectopic Pregnancy by Hysterosalpingography Borge Nielsen *Acta radiol., Stockh* 1947 28 185

Hysterosalpingography is infrequently a diagnostic aid in ectopic pregnancy. A 35 per cent water soluble contrast media is used and films are made in varying projections. The rate of media absorption as well as the manner in which the contrast media fills the pregnant tube are observed by serial films.

Pertinent roentgen findings are

1. Lack of filling of the salpinx and uterine atony
2. Segmental irregularity of the obstructed salpinx
3. Salpinx spasm
4. Nonvisualization of the ovum in the tube.

The author reports the cases of 25 patients on whom hysterosalpingography was done for suspected ectopic pregnancy. Among the first 12 instances the roentgen findings were positive in 11. In the second group of 13 cases it was desired to rule out ectopic pregnancy, and this was done in 12 of them.

The author believes that the danger of miscarriage is not a contraindication to the procedure. However the procedure should not be done indiscriminately. This examination is certainly a worthwhile adjunct to the clinician's diagnostic armamentarium.

MAURICE D. SACHS, M.D.

An Epidemic of Inhalation Lead Poisoning with Characteristic Skeletal Changes in the Children Involved George Cooper Jr *Am J Roentg* 1947 58 219.

The clinical picture of various manifestations of plumbism have been described many times since about 300 B.C. when Hippocrates recorded his findings in a case of lead colic in an extractor of metals. Prompt recognition of plumbism in children is more important than in adults for children react to small amounts of lead and more severely. This is true especially of those under 4 years of age. Epidemics of lead poisoning have been reported in which the source of the lead was traced to the use of storage battery casings for fuel. In Stanton, Virginia there was an epidemic due to this cause. The author discusses the findings in the 19 patients examined. Only 4 patients failed to show abnormal metaphyseal densities on roentgen examination.

The symptomatology in poisoning due to lead inhalation is identical with that due to lead ingestion. The incidence of ingested lead poisoning is highest in spring and summer because the vitamin D producing action of sunlight increases the absorption of ingested lead as well as of calcium. There is no seasonal incidence from inhaled lead. The early symptoms are gastrointestinal—loss of appetite, vomiting, constipation and abdominal cramps. Persistent and



Fig. 1 (Nielsen) A hypermobile uterus which ejected the perabrodil through the fallopian tubes immediately. The pregnant salpinx ends in the shape of a funnel, but it is partly covered with irregular stripes and patches of contrast medium.

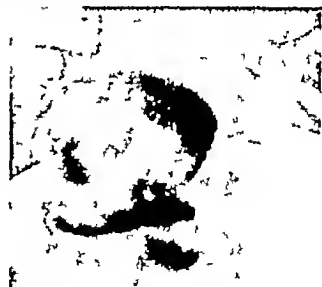


Fig. 2 (Nielsen) Same as figure 1 but some time after the injection. The contrast medium is more distinctly visible.

more severe poisoning frequently leads to peripheral neuritis and palsy in adults and occasionally in children. Anemia is a fairly constant finding. Meningo-encephalitis is the most serious development. It is frequent in children. The symptoms are persistent projectile vomiting, changes in the victim's mental state (irritability and lethargy), visual disturbances and alteration of the pulse and respiratory rates. These initial symptoms are followed by delirium, stupor, coma, elevated blood pressure, choked optic discs, convulsions and separation of the cranial sutures.

tures. Corneal and optic atrophy are frequent sequelae.

In children the most valuable diagnostic procedure is roentgenographic examination of the skeleton. The x-ray findings are those of homogeneous metaphysical densities. The zones of increased density vary in width up to about 0.5 cm. and vary in density.

The metaphysical densities are most marked where the bone growth is most active—in the ends of the long bones at the anterior ends of the ribs and in the iliac crest. There are several other conditions which produce zones of increased density in the metaphyses. The diagnosis of lead poisoning cannot be made without confirmation from the history and clinical findings. F. W. L. HUNTER, M.D.

Further Observations on Fracture of the First Rib. D. Rosby Alderson, *Bull. J. Radiol.* 1947 30 345

The author published in November 1914 an article on "Stress Fractures of the First Rib." Various American workers denied the possibility of a spontaneous fracture of the first rib and believed that such an injury could occur only from direct trauma. The author believes that fracture of the first rib does occur frequently from muscular violence; that complete bony union does occur; that nonunion and the formation of a false joint are encountered; that there may be symptoms sufficient to cause the patient's report to his physician; and also that this condition more frequently occurs without sufficient pain to require radiological examination or even to warrant a visit to the doctor.

There is presented a series of case histories of subjects showing the abnormality under review. In one or both first ribs showing evidence of the fracture, sometimes spontaneously, with or without subjective symptoms, sometimes following severe and usually unaccustomed muscular stress, either related to a single episode or more frequently to a particular kind of job, namely, the lifting and carrying of heavy weights.

The radiological evidence has been supported by roentgenocryptoscopia in some cases demonstrating the healing process and in some cases complete bony union occurred. In other cases research into the roentgenograph revealed a bone spur or growth, but no definite fracture. The author believes it is probable that spontaneous fracture of the first rib is more common than congenital abnormality. ALAN D. O. MURPHY, M.D.

The Roentgen Appearance of Primary Reticulum Cell Sarcoma of Bone. Robert S. Sherman and Ruth Evelyn Snyder, *Am. J. Roent.* 1947 5 121

Since then a number of other case reports have appeared in the literature.

The authors observed 17 cases of primary reticulum cell sarcoma of bone, all of which were confirmed histopathologically by at least one biopsy.

The literature contains no reference to the nature of the roentgen studies in reticulum cell sarcoma of bone although often the appearance is highly characteristic. The following factors are of importance:

1. Location in skeletal system. About 75% of the tumors involve the tubular bones of the long bones located in the region of the knee.

2. Location in bone. The tumors may occur in the diaphyseal, metaphyseal or epiphyseal region so that the location in bone has no particular significance.

3. Site of origin. In the vast majority of cases tumors arise from the medullary or cancellous bone.

4. Symmetry in bone. This occurs in 10% of the bones. About one third of the tumors are symmetrical.

5. Direction of growth. In one-half the cases the growth of the tumor is entirely endosteal, in the other half with very few exceptions it is predominantly endosteal.

6. General configuration. An oval configuration occurs most frequently with the following characteristics:

7. Destruction and production in medullary bone. Medullary destruction is a constant feature. Productive changes, i.e., bone formation, calcification, or osteoclastic deposits, are observed in about one-half of the cases but rarely exceed the destructive changes.

8. Structure of the tumor. The structure of the osseous portion is a patchy arrangement of areas of destruction intermingled with similar areas of production. The periosteal portion has no pattern there being no calcification in the soft tissue now apart from the periosteal reaction.

9. Boundary of the tumor. One of the outstanding features of reticulum cell sarcoma of bone is its ill defined boundary so that it is very difficult to determine the precise extent of the tumor.

10. Condition of the cortex. Cortical thickening is a constant finding but no expansion or malformation of the cortex is present.

11. Condition of periosteum. Perfectly normal periosteal reaction is found on cancellous bone but in the thin areas of the cortex the periosteum is often irregular with a moderate periosteal reaction at the margins of the tumor.

12. Periosteal reaction. The majority of the

15 **Multiplicity** There is never involvement of more than one bone.

16 **Rate of growth** The duration of symptoms for an average of 6½ months as well as the roentgen findings of periodical check up examinations suggest that reticulum cell sarcoma is a rather actively growing tumor.

17 **Response to irradiation** The immediate response is very satisfactory. The penosaceous mass disappears first, followed by re-establishment of the cortex, absindence of the periosteal change and finally by reossification of the destroyed area the density being slightly greater than in the normal bone. The late results, likewise are very encouraging. In the authors series 5 patients are well 3 years or more after treatment, 5 patients are well 3 years after treatment 3 died and the remainder were treated more recently.

The differential diagnosis of reticulum cell sarcoma of bone from osteogenic sarcoma of medullary origin is often difficult. The most important distinguishing signs are the radioresistance of the osteogenic sarcoma in contrast to the reticulum cell sarcoma and the lack of reparative changes following roentgen therapy. Other conditions that have to be considered in the differential diagnosis are Ewing's tumor metastatic cancer in bone osteomyelitis tuberculosis, neuroblastoma and lymphoblastoma.

The case histories of all 17 patients are presented and their respective roentgenograms reproduced for the purpose of illustration.

The conclusion is reached that reticulum cell sarcoma of bone is relatively benign and runs a long course with not infrequent 5 year survivals. Irradiation constitutes the sole method of treatment and there is some evidence that it may be a radiocurable tumor.

T. LEUCUTIA, M.D.

Roentgen Diagnosis of Pigmented Villonodular Synovitis and Synovial Sarcoma of the Knee Joint. Raymond W. Lewis. *Radiology* 1947 49 16.

In 1941 Jaffe, Lichtenstein and Sutro grouped under the name of pigmented villonodular synovitis of the knee joint, lesions formerly described in the literature under a wide variety of designations such as chronic hemorrhagic villous synovitis, giant cell fibrohemangioma, fibrohemosideric sarcoma, sarcoma fusigigantocellulare, benign polymorphocellular tumor of the synovial membrane, xanthoma, xanthogranuloma, giant cell tumor and myeloplasmoma. They distinguished between a circumscribed and diffuse form of villonodular synovitis and considered the condition as inflammatory rather than neoplastic.

In the present preliminary report the author deals with the diffuse villonodular synovitis, since the circumscribed lesions are seldom demonstrated roentgenographically. His experience extends to 4 surgically proved cases, which are described in the text, and 7 cases studied only by clinical and roentgenographic means.

The general roentgen characteristics of the diffuse villonodular synovitis and the diffuse intracapsular tumors of the knee joint of which synovial sarcoma (synovioma) is the most common are often identical. They are as follows: bones of a young adult monarticular involvement, excessive amount of synovial tissue which may appear smooth in outline and homogeneous in density or nodular in outline and of varying density, normal joint spacing with no indication of cartilage involvement and complete absence of osteoporosis or atrophy of the leg.

Clinically as a rule there is a long history of swelling of the knee extending from one to several years, no known etiology, relatively little discomfort or disability, no fever and a normal or somewhat increased sedimentation rate.

Although as mentioned above diffuse villonodular synovitis and synovial sarcoma of the knee joint are frequently identical in their roentgen appearance the author found 3 criteria which may permit a differentiation: (1) if the nodular soft tissue masses are in part or wholly outside of the joint capsule, the lesion is not villonodular synovitis, but may be synovial sarcoma, fibrosarcoma or some other condition; (2) if the lobulated soft tissue masses in or near the joint contain scattered or irregular deposits of amorphous lime, the lesion is almost certainly a synovial sarcoma; and (3) if the lesion of the soft tissues of the joint has invaded bone the condition is probably synovial sarcoma.

In the 4 cases described in the text the treatment consisted of one or several synovectomies. However the results were so disappointing that in the more recent cases roentgen therapy is being tried. Some good results from roentgen therapy in villonodular synovitis are described in the literature.

In view of the importance from the point of view of treatment of establishing a differential diagnosis between villonodular synovitis and synovial sarcoma, exploratory operation and biopsy would seem definitely indicated in every case.

The article is illustrated with typical roentgenograms and drawings showing the salient points.

T. LEUCUTIA, M.D.

Panroentgen Therapy from the Clinical, Technical and Biological Point of View (La panroentgenoterapia dal punto di vista biologico, tecnico e clinico). Ardino Ratti. *Radiol. med.*, Milano 1947 32 306.

The author in a lengthy article considered it proper to make an examination of the biological, technical and clinical problems involved in panroentgen therapy (total irradiation of the body with therapeutic roentgen rays) to see how and when much more extended use might be justified. He traces the origin of the idea (submitting the whole body contemporaneously to the therapeutic action of roentgen rays) to the beginnings of the radiological era. Its advancement proposed by Dessauer (1905) and the first clinical applications by Teschendorf (1927), Dale (1928) and Sgalitzer (1932). He believes the term

field for the use of panroentgen therapy is that of the chronic hemopathies especially the not advanced forms. The results in the cases of malignant lympho-granuloma were nearly all negative and in the cases of generalized malignant neoplasms the results were questionable

G ALBIN LIVA, M.D

Irradiation of Experimental Cerebral Tumors. Experimental Production of Brain Tumors in Mice. Katharine Tansley *Radiology* 1947 49 62.

In the first part of this article Tansley deals with the experimental production of brain tumors in mice. After a detailed review of the literature the author describes the method used by herself. Benzpyrene and methylcholanthrene powders have been used. The latter has proved much more successful. 24 sarcomas and 10 gliomas having been obtained in 77 animals. Two strains of mice were used the albino N1 strain, originally obtained from the National Institute for Medical Research London and a mixed pigmented stock of uncertain origin bred in her own laboratory. Because of experimental difficulties only 1 glioma was preserved for transplantation. This now has been successfully transmitted to 103 mice of the N1 strain.

The operation for implanting the carcinogen into the brain tissue was performed when the mice were 2 days old. The glioma used for grafting was obtained from an animal 397 days after the implantation of methylcholanthrene. The operation for the implantation into the brain of the glioma grafts was likewise performed when the mice were 2 days old. Grafts of glioma tissue were successful in every animal that survived the operation. The macroscopic and microscopic appearances of the induced tumors and the grafted gliomas are discussed in detail. Several photomicrographs being used for the purpose of illustration. In general, the grafted gliomas resembled the cerebral tumor described by Lopez in a rat and said by him to be similar to a human glioblastoma isomorphic. The tumor cells invaded the brain particularly through the perivascular and ventricular spaces they also penetrated the true brain tissue without producing any visible reaction or round cell infiltration.

In the second part of the article, Tansley and Wilson give their observations on the effect of roentgen irradiation on the grafted gliomas, 39 of the 85 grafted mice having been subjected to this procedure. The treatment was carried out with 180 kv. (Villard circuit) 0.5 mm. of copper plus 1.0 mm of aluminum which gave a high value layer of 0.95 mm. of copper at a distance of 35 cm and a dose rate of 154 roentgens per minute. The experimental arrangement is described and illustrated with diagrams.

Total doses of from 1 623 to 3,247 roentgens were administered. The effect of irradiation on the growth of the tumor varied greatly. In general, the higher doses were more effective in arresting the growth, but in no case was the tumor entirely destroyed. Five animals died during or within a few hours of the

exposure all showing profuse hemorrhages from the tumor tissue. Other animals were examined from 7 to 18 days after irradiation and were found to exhibit widespread necrosis and diffuse bleeding in the tumor tissue.

T LEUCUTIA, M.D

The Treatment of Recurrences and Evaluation of Criteria for the Selection of Treatment of Cancer of the Larynx. John V Blady *Am J Roentg.* 1947 58 331

There are three well established methods for the treatment of cancer of the larynx laryngofissure laryngectomy and irradiation.

The purpose of the present study is to review the recurrences that developed at the Temple Univer-

Criterion	Recommended Treatment
Metastases Cervical metastases present	Irradiation 1. primary lesion Irradiation and/or surgery and/or radio
b. Cervical metastases absent	Laryngofissure 1. Laryngectomy 2. Irradiation
Histopathology a. Squamous cell carcinoma, Grade 1 and 2	Laryngofissure Laryngectomy 3. Irradiation
b. Squamous cell carcinoma, Grade 3	1. Laryngofissure Laryngectomy
c. Squamous cell carcinoma, Grade 4	Irradiation In early cases limited to 30 ph. 30. Laryngofissure may be indicated
Extent of Involvement a. Growth limited to one cord, not involving arytenoid or posterior commissure	Laryngofissure
b. Growth limited to anterior commissure and anterior third of each cord	Laryngofissure 1. Irradiation
Growth involving one cord, ventricle	Laryngofissure
d. Subglottic extension	Laryngectomy
Growth involving anterior commissure, cord and base of epiglottis	Laryngectomy
f. Growth involving cord, ary-epiglottic fold with limitation of mobility	Irradiation 2. Laryngectomy
a. Growth involving posterior commissure, pyriform fossa, aryepiglottic fold and epiglottis, or partly well	Irradiation
Mobility and Stability Impaired mobility of cord	Irradiation Laryngectomy
b. Partial impairment of mobility of larynx	Laryngectomy Irradiation
c. One side of larynx fixed or greatly impaired	Laryngectomy
General Factors a. Presence of other disease contraindicating radical surgery	1. Irradiation Laryngofissure
b. Temperament of patient—If patient cannot become adjusted to laryngectomy	Irradiation

higher as well as earlier incidence in mice following doses as low as 11 roentgens per day when compared to the controls.

Histological studies as well as breeding experiments showed that radiation injury to the ovary of the mouse is irreversible and cumulative. Radiation injury to the testes of mice and guinea pigs on the other hand is reversible and cumulative only to a certain degree. No conclusive evidence for the production of genetic changes was obtained in studies on mice exposed continuously up to six generations to 1 roentgens per day after fertilization of the ova took place.

The following conclusions were drawn by the authors from their experimental results. The blood picture is of little value in determining radiation damage except in the case of obvious overexposure. The carcinogenic action and sterility effects dominate the picture of radiation injury. The present permissible dose of 1 roentgen per day in the human should be maintained. Due to the considerably higher as well as earlier incidence of ovarian tumors in mice following cumulative doses of 11 roentgens per day when compared to that in the controls the permissible dose should be reduced for women to perhaps 0.2 roentgens per day or their time of exposure should be reduced to a few years. Since there was no evident radiation injury to the skin of experimental animals exposed to 8.8 roentgens given in 8 hours per day to a total dose up to 10,000 roentgens a permissible dose to the hands of 1 roentgen per day might be considered safe if the rest of the body does not receive more than 1 roentgen per day.

J H FRIED M D

The Hematological Effects of Ionizing Radiations in the Tolerance Range. Leon O Jacobson and E. K. Marks. *Radiology* 1947 49 286.

The authors report the effect of continued whole body irradiation from gamma rays on the hematopoietic system of mice, rabbits and guinea pigs with daily doses of 8.8 4.4 2.2 1.1 and 0.1 roentgens given in 8 or 24 hours per day for periods as long as 3 years. This work was done in conjunction with controlled studies of the peripheral blood of personnel exposed or potentially exposed to radiation during work performed on the Plutonium Project.

From the results of these studies the authors conclude that a lymphocyte reduction in the peripheral blood is the most sensitive indicator of acute or subacute exposure to externally originating ionizing radiation or internally deposited radioisotopes. No hematological change was detectable in the peripheral blood in mice rabbits or guinea pigs with a daily whole body exposure to 0.1 roentgen gamma radiation extending over 3 years. In some of the timed exposures of 0.1 roentgen per day even though no peripheral blood changes were noted. All three species of animals exposed to doses of 2 4.4, or 8.8 roentgens showed definite hematological changes of

significance after varying lengths of time. The guinea pig is the most sensitive, the mouse intermediate, and the rabbit most resistant so far as hematological changes produced by radiations are concerned.

In studies on the personnel of the Plutonium Project no hematological changes were found which were referable to radiation exposure in the tolerance range. The results of this experimental work however indicate that studies of the hematological constituents of peripheral blood are not reliable for determining possible incipient damage from radiation exposure in the tolerance range, and therefore other clinically applicable tests are urgently needed.

J H FRIED M D

The Tolerance Dose and the Prevention of Injuries Caused by Ionizing Radiations. Rolf M. Sievert. *Brit J Radiol.* 1947 20 306

The risks of radiation injuries have been steadily increasing during the past 25 years because of the use of increasing intensities of x radiation and greater quantities of radioactive substances and because of wider use in such fields as research teaching and engineering where medical knowledge is often lacking and where their administration is in the hands of personnel not familiar with their biological effects. The possible use of atomic energy in the future will further greatly increase the problem of protection against injuries by ionizing radiations and it is probable that it will become a general social problem of prime importance.

In considering protection against radiation interest is concentrated on the effects of the ionizing rays on three parts of the human organism the skin the blood and blood forming tissues and the sex glands and germ cells. The so-called safe tolerance dose is of fundamental importance in all work concerning the prevention of radiation injuries. From previous studies, the safe skin tolerance dose may be fixed at between 0.1 and 0.5 roentgens per day. In determining the blood tolerance dose the term integral dose introduced by Mayneord in 1940 is of importance because it gives a measure of the total energy absorbed by the body. It will be of great value for assessing the risks due to high energy protons and neutrons of which the safe tolerance dose may be much smaller than that recommended for x rays and gamma rays because of their greater biological effect correlating the blood changes with radiation risks in the use of x rays and gamma rays have shown that in all probability radiation quantities as low as from 0.2 to 0.5 roentgens per day can give rise to blood changes after a comparatively short time. The genetic tolerance dose appears to be of the order of magnitude of 100 roentgen per day. Hence, the author believes that a safety tolerance of 10 roentgen per day should not, if possible, be exceeded.

The prevention of injuries caused by ionizing radiation is mainly a question of organization. In Sweden, supervision of establishments using x rays and

Discussion on Radiotherapy in the Treatment of Nonmalignant Superficial Eye Lesions. R. Affleck Greaves, B W Windeyer M Loderman N S Finzi and Others. *Proc R Soc M., Lond.*, 1947 40 570.

R. Affleck Greaves deals solely with the treatment of superficial corneal lesions by means of mild suberythematous radiotherapeutic doses. Eighteen years ago he began treating corneal lesions which occurred in connection with cases of acne rosacea keratitis. Improvement was noted. The eyes whitened infiltrates were replaced by healing scars, and pain and photophobia vanished. He states that radiotherapy does not cure the disease. Exacerbations which are especially prone to occur in spring and early summer can be checked in most cases by means of radiotherapy if this treatment is instituted early. Radiotherapy has proved to be markedly beneficial in recurrent abrasions and superficial punctate keratitis. In these cases the ulceration is usually limited to the corneal epithelial layer and heals without leaving any scar. In some cases attacks may continue in a moderate form after a course of treatment. After a suitable interval treatment may be required. About one half of the patients with superficial punctate keratitis who have been treated have been benefited. Only in obstinate cases of phlyctenular keratitis has it been found necessary to use radiotherapy. In mild cases of spring catarrh when eyelids are normal during the winter months and show fresh manifestations in the early part of each year treatment is indicated. Treatment should be immediate in cases of recurrence. In treatment of other types of corneal ulcer including Mooren's ulcer and deodritic ulcer and any form of deep keratitis radiotherapy has not been successful. B W WINDEYER states that the cardinal principle in radiotherapy of malignant disease of the eye is to avoid or shield the eye itself whenever possible, because of the danger of permanent damage from even moderate dosage. The most common sequelae are those associated with the eyelids and the lacrimal apparatus the conjunctiva, and the lens. Scarring of the lids may cause entropion or ectropion, and closure of the punctum by scar tissue may result in persistent epiphora. Heavy irradiation of the conjunctiva may be followed by chronic conjunctivitis with some loss of sensitivity and chronic irritability. In such cases vascular changes are usually apparent. Microscopically there is degeneration of the arterial vascular endothelium, followed by regenerative hyperplasia with narrowing of the lumen of the vessels, and clinically there is dilatation of the superficial capillaries with permanent telangiectasis. Degeneration of the lens with cataract formation may occur. Typical irradiation cataract is posterior cortical with radiating rows of vacuoles and these may be arrested in the vacuolar stage or may go on to maturity vacuolar opacities gradually becoming scattered through the entire lens cortex, which eventually becomes completely opaque. A mature irradiation cataract shows no special clinical features and re-

sponds as well to operative treatment as do other forms of cataract. The technique used at the Middlesex Hospital has been irradiation of the cornea from the lateral and from the medial sides with a beam which is sharply defined by means of a lead glass applicator with a 2 to 3 cm. diameter aperture. The patient is treated with the eye open and fixated in one position. A dose of 100 roentgens measured at the aperture of the applicator is delivered to each field. The estimated dose received by the cornea is a total between 120 and 130 roentgens per treatment. This dose is repeated at fortnightly intervals up to 4 treatments per series. This treatment may be repeated. The treatment of cases of acne rosacea keratitis gives the most gratifying results. Recurrent erosion and abrasion respond with rapidity but may recur. Superficial punctate keratitis of the multiple erosion type has shown satisfactory response in one-half of the cases. The results of treating spring catarrh have been disappointing.

M LUDERMAN states that radiotherapy has not yet received the recognition it merits by ophthalmologists. The reasons for this are twofold (1) current misconceptions concerning the susceptibility of the eye to radiation damage and (2) the eye diseases for which radiotherapy is suitable are not common hence its field of usefulness is rather restricted. The view that the eye is readily damaged by radiation cannot now be supported as it is largely based on early unsatisfactory experimental work and the ocular disasters encountered by pioneer radiotherapists. Damage to the eye is avoidable in the treatment of nonmalignant lesions but the risk of ocular damage has to be accepted in the treatment of malignant neoplasms which affect the eye or its neighboring structures. Radiation with beta and gamma rays and x rays can be used, each have their own indications. Hemangioma keloids, solitary papillomas, and hyperkeratosis are benefited by radiation therapy. For inflammatory lesions it is less satisfactory and should not be used without additional consideration. In superficial punctate keratitis and rosacea keratitis x ray radiation is of value. An initial dose between 10 and 15 roentgens is used which is gradually increased to from 40 or 50 roentgens per treatment twice weekly until a total dose from 200 to 350 roentgens has been given. Individualization of the treatment is advisable. Corneal ulceration and recurrent erosion are favorably influenced by radiotherapy. Mooren's ulcer presents a special problem. The results of treatment are variable.

A. J. DURDEN SMITH states that Mooren's ulcers are treated by contact radiation with unscreened radium applicators. As a rule 3 treatments at intervals of 6 weeks are given. The dosage of the radium applicators used is of full strength i.e., 5 mgm per square centimeter and is substantially unscreened—the contact surface consisting of 0.1 mm of monel metal. The most usual sizes are 1.0 and 1.25 cm in diameter. The typical applicator gives 6,000 roentgens on the surface. The treatment time is short. Forty ulcers were treated. Eighteen of these healed

radioactive substances is now required by law and such supervisory work is carried out largely by the Institute of Radio-Physics. Every person wishing to be employed in radiological work is obliged to undergo a periodic medical examination. A 6 week holiday has been established for all x ray workers periodic inspections are made of all establishments using x ray or radioactive substances and recommendations for protection are made and enforced. Such control work is organized in combination with research and teaching.

Propaganda and instruction appear to be the most important measures for preventing radiation injuries according to the author. A careful and satisfactory working technique is clearly the most important protective measure. Such a system of regulatory control seems desirable and will undoubtedly be adopted by other countries with the advent of the new atomic age. J. W. H. FAY D. M.D.

Effects of Total Surface Beta Irradiation. John R. Raper. *Radiology* 94:749-54.

Because of superficial absorption, radiation with beta rays in doses below the acute lethal range results in greater gross and superficial damage than that following irradiation with x rays or gamma rays. The lesions produced are inflammation and swelling of the epidermis, dryness of the skin, and ulceration of the skin.

It was found that the larger the animal the greater the time required. Total surface beta irradiation is an acute lethal action in each species at a characteristic dose, but the main wave of mortality occurs later than that noted following irradiation with x rays. The median lethal dose (LD 50) for each species noted from baby rats at 2,200 r.e.p. (roentgens equal to 1 g.h. usual) to rabbits at 17,000 p.

Studies indicated that beta rays a strictly superficially absorbed radiation, leaving about their lethal action by a total skin volume effect while gamma rays which penetrate all elements of the body more or less uniformly do not.

A series of experiments showed that the greatest mortality was in the first 3 days following sublethal irradiation and within 8 days complete recovery is attained. It was suggested that there is a period of convalescence after which no obvious explanation is found.

Other studies showed no direct effect on the cellular activity of the peripheral blood.

JAMES O. LAFRANCE M.D.

Experiments on the Mechanism of the Biological Action of Fast Neutrons. J. S. Mitchell. *Brit J Radiol* 1947 20:53.

The author has made a quantitative comparison of fast neutrons with mean energy between 4 and 5 m.e.v. from a polonium beryllium source and a radium gamma ray source. The estimation method for lethal effects in a female mouse. The experiment was performed to determine whether the

relevant mechanisms of the biological action of neutrons are identical with or differ from those of gamma radiation and whether the effects of the two radiations are completely additive. Determinations were also made of the relative biological efficiency of the two radiations for unit energy dose with different overall exposure times.

The contributions to the tissue dose from fast neutrons and the accompanying gamma rays were determined by measurement of the dose of the ionization in lead by means of small ionization chambers with walls of graphite and a carbon polystyrene mixture. One roentgen of fast neutrons is defined as the dose which produces the same energy absorption per unit volume of tissue as that produced by 1 roentgen of the usual filtered gamma radiation of radium of mean energy approximately 0.8 m.e.v.

Two series of biological summation experiments were carried out. The first involving 24 individual experiments with a mean overall time of exposure of 24 hours and the second 38 individual experiments with a mean overall exposure time of 48 hours. The "mixed" radiations applied consecutively in the orders were mainly one third dose control and one type of radiation and two-thirds dose of the other and vice versa but 50 per cent of the experiments were also used in the second series.

In both series of experiments statistically significant departures from additivity were found following the deaths in from 0 to 20 days after exposure. The mixed radiations consecutively applied were found to have less lethal effect than comparison of either fast neutrons or gamma radiation alone. This result indicates a difference in the mechanism of the biological action of these two radiations. The author explains this difference in the mechanism of biological action of fast neutron and gamma rays as probably being due to a difference in the mechanism of action on the cells. Proliferating cells are more sensitive to gamma radiation during a short interval in the prophase stage of mitosis. It is likely that on account of the high specific ionization of fast neutrons the proliferating cells exhibit a more uniform sensitivity to neutrons than cells in the "resting" stage and mitosis was therefore of the length of the former the main effect of fast neutrons will be shown by resting cells. With regard to tolerance problem it is believed that the effects of fast neutrons and gamma radiation are comparable, nevertheless, be regarded as a dilution from the present standpoint.

The relative biological efficiency of fast neutrons in terms of the efficiency of the gamma radiation was found in the experiments with a mean exposure time of 48 hours to have the value of 3.0 ± 0.6. This is significantly higher than the value for short exposure times. The author believes that this indicates that the lethal effects of gamma rays on normal mammalian cells are produced in part by chromosome effects.

J. W. H. FAY D. M.D.

Discussion on Radiotherapy in the Treatment of Nonmalignant Superficial Eye Lesions. R. Affleck Greaves, B. W. Winder, M. Lederman, N. S. Finzi and Others. *Proc. R. Soc. M., Lond.*, 1947 40 570.

R. Affleck Greaves deals solely with the treatment of superficial corneal lesions by means of mild suberythematous radiotherapeutic doses. Eighteen years ago he began treating corneal lesions which occurred in connection with cases of acne rosacea keratitis. Improvement was noted. The eyes whitened, infiltrates were replaced by healing scars, and pain and photophobia vanished. He states that radiotherapy does not cure the disease. Exacerbations which are especially prone to occur in spring and early summer can be checked in most cases by means of radiotherapy if this treatment is instituted early. Radiotherapy has proved to be markedly beneficial in recurrent abrasions and superficial punctate keratitis. In these cases the ulceration is usually limited to the corneal epithelial layer and heals without leaving any scar. In some cases attacks may continue in a moderate form after a course of treatment. After a suitable interval treatment may be required. About one half of the patients with superficial punctate keratitis who have been treated have been benefited. Only in obstinate cases of phlyctenular keratitis has it been found necessary to use radiotherapy. In mild cases of spring catarrh when eyelids are normal during the winter months and show fresh manifestations in the early part of each year treatment is indicated. Treatment should be immediate in cases of recurrence. In treatment of other types of corneal ulcer including Mooren's ulcer and dendritic ulcer and any form of deep keratitis radiotherapy has not been successful. B. W. WINDER states that the cardinal principle in radiotherapy of malignant disease of the eye is to avoid or shield the eye itself whenever possible, because of the danger of permanent damage from even moderate dosage. The most common sequelae are those associated with the eyelids and the lacrimal apparatus, the conjunctiva and the lens. Scarring of the lids may cause entropion or ectropion and closure of the punctum by scar tissue may result in persistent epiphora. Heavy irradiation of the conjunctiva may be followed by chronic conjunctivitis with some loss of sensitivity and chronic irritability. In such cases vascular changes are usually apparent. Microscopically there is degeneration of the arterial vascular endothelium followed by regenerative hyperplasia with narrowing of the lumen of the vessels and clinically there is dilatation of the superficial capillaries with permanent telangiectasis. Degeneration of the lens with cataract formation may occur. Typical irradiation cataract is posterior cortical with radiating rows of vacuoles and these may be arrested in the vacuolar stage or may go on to mature. Its vacuolar opacities gradually becoming scattered through the entire lens cortex which eventually becomes completely opaque. A mature irradiation cataract shows no special clinical features and re-

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M. LEDERMAN states that radiotherapy has not yet received the recognition it merits by ophthalmologists. The reasons for this are twofold: (1) current misconceptions concerning the susceptibility of the eye to radiation damage and (2) the eye diseases for which radiotherapy is suitable are not common, hence its field of usefulness is rather restricted. The view that the eye is readily damaged by radiation cannot now be supported as it is largely based on early unscientific experimental work and the ocular disasters encountered by pioneer radiotherapists. Damage to the eye is avoidable in the treatment of nonmalignant lesion but the risk of ocular damage has to be accepted in the treatment of malignant neoplasms which affect the eye or its neighboring structures. Radiation with beta and gamma rays and x rays can be used; each have their own indications. Hemangioma, keloids, solitary papillomas and hyperkeratosis are benefited by radiation therapy. For inflammatory lesions it is less satisfactory and should not be used without additional consideration. In superficial punctate keratitis and rosacea keratitis x ray radiation is of value. An initial dose between 10 and 15 roentgens is used which is gradually increased to from 40 or 50 roentgens per treatment twice weekly until a total dose from 200 to 250 roentgens has been given. Individualization of the treatment is advisable. Corneal ulceration and recurrent erosion are favorably influenced by radiotherapy. Mooren's ulcer presents a special problem. The results of treatment are variable.

A. J. DUKOEN SURIN states that Mooren's ulcers are treated by contact radiation with uncrenelated radium applicators. As a rule 3 treatment at intervals of 6 weeks are given. The dosage of the radium applicators used is of full strength, i.e. 5 mgm per square centimeter and is substantially uncrenelated—the contact surface consisting of 0.5 mm of metal mesh. The most usual sizes are 1.0 and 1.5 cm in diameter. The typical applicator gives 6,000 roentgens in the surface. The treatment time is short. Forty ulcers were treated. Eighteen of these healed

radioactive substances is now required by law and such supervisory work is carried out largely by the Institute of Radio-Physics. Every person wishing to be employed in radiological work is obliged to undergo a periodic medical examination. A 6 week holiday has been established for all x-ray workers. Periodic inspections are made of all establishments using x-ray or radioactive substances, and recommendations for protection are made and enforced. Such control work is organized in combination with research and teaching.

Preparation of instructions appear to be the most important measures for preventing radiation injuries according to the author. A careful and satisfactory working technique is clearly the most important protection measure. Such a system of regulatory control seems desirable and will undoubtedly be adopted in other countries with the consent of the responsible agencies. J. W. H. L. 10 31 D

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Because of superficial absorption, irradiation with beta rays in doses below the acute lethal range results in great gross and superficial damage than that following irradiation with x-rays or gamma rays. The lesions produced are inflammation and swelling of the epidermis, dryness of the skin and ulceration of the skin.

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Studies indicate that beta rays are strictly superficially absorbed, resulting in bringing about their lethal action by a total mass or volume effect while gamma rays which are less penetrating of the body mass are less uniformly lethal.

A series of experiments showed that the greatest mortality in the first 3 days follows a sublethal dose and with a 3 day complete recovery is followed by this there is a period of complete tolerance with no obvious explanation is found.

Blind studies showed no direct effect on the cellular contents of the peripheral blood.

J. W. O. LARSEN, M.D.

Experiments on the Mechanism of the Biological Action of Fast Neutrons. J. S. Mitchell. *Proc J Pathol* 1916 20 37

The author has made a quantitative comparison of the relative biological effectiveness between a dose of 100 r.p.m. from a point source and a dose of 100 r.p.m. from a point source and a dose of 100 r.p.m. from a point source. The experiments are performed chiefly in terms of the

relevant mechanisms of the biological action of neutrons are identical with or differ from those of gamma radiation and whether the effects of these radiations are completely additive. Determinations were also made of the relative biological effectiveness of the two radiations for unit energy absorbed with different overall exposure times.

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Two series of biological summation experiments were carried out. The first involving 21 rats and experiments with a mean overall time of exposure of 24 hours and the second 38 individual experiments with a mean overall exposure time of 48 hours. The "mixed" radiations applied consecutively in different orders were mainly one third dose of neutrons and one type of radiation and two-thirds dose of the other, and vice versa, but 50 per cent of the rats were also used in the second series.

In both series of experiment statistically significant departures from additivity were found following the death in from 20 to 30 days after irradiation. The "mixed" radiations consecutively applied were found to have less lethal effect than comparison of either fast neutrons or gamma radiation. This result indicates a difference in the mechanism of the biological action of these two radiations. The author explains this difference in the mechanism of biological action of fast neutrons and gamma rays as probably being due to a difference in the action on the cells. Proliferating cells are sensitive to gamma radiation during a short period in the prophase stage of mitosis. It is likely that on account of the high specific ionization of fast neutrons the proliferating cell exhibits a more or less sensitive vitri to neutrons than the resting stage and mitosis so that because of the length of the former the main effect of fast neutrons will be to destroy resting cells. With regard to tolerance problems it is believed that the effect of fast neutrons and gamma rays is additive from the standpoint.

The relative biological effectiveness of fast neutrons in terms of the efficiency of the gamma rays was found in the experiments with a mean exposure time of 48 hours to have the value of 3.0 to 3.6, i.e., a gamma ray is 3 to 4 times more effective than a fast neutron for unit energy absorbed. The author believes that this indicates that the lethal effects of gamma rays on normal mammalian cells are produced in a different mechanism from fast neutrons.

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and presented no recurrence for period of 2 years or more. Seventeen lesions were bilateral on arrival. Of these 7 healed on both sides as a result of treatment. Four healed on one of the sides but not on the other and the remaining 6 failed to heal on either side.

W. S. FRIEDMAN said that it was necessary to point out that gamma radiation would not fall off in anything like the same degree per millimeter of tissue as the beta radiation. In that Durden Smith has stated that he gave 6,000 roentgens of the beta radiation.

THORNE WOLFF said that he had seen half a dozen cases of stenosis of the punctum and canaliculus after radiation.

B. THORNE THORNE asked if radium or x-ray application would bring about relief in a case of dermoid poma of both eyes.

WILDEYER felt confident that the dosage which he had described had been given. He did not think that splitting of the canaliculus would correct scarring of the punctum (Wolff). He thought a dermoid poma would quite unlikely be radioreducible (Thorne Thorne).

M. LEDERMAN in referring to the dosage and the treatment of Mooren's ulcer said that with a consistent dose.

FRANK L. HERRICK

Radium Therapy of Hemangioendothelioma of the Uterine Cervix Harry H. Bowling, Robert L. Fricke and James T. McGowan, *Am J Surg* 1947 57 653

The authors report 4 cases in which a hemangioendothelioma occurred in or on the cervix. Of 4 patients 2 are dead but their death can be attributed directly to the neoplasm of the cervix. Two of the neoplasms occurred in unmarried women. In multiparous women. The youngest patient was 39 years of age the oldest 63. The most prominent symptom was bleeding. In these patients menstruation still occurred there was not a prolongation of the menstrual periods with increase in the amount of blood at the periods. Vaginal discharge was not a prominent symptom even when vaginal vault was filled by the tumor. The tumor seemed very radiosensitive which usually is true of tumors of endothelial origin.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Sequelae of Atomic Bomb Explosion George V. LeRoy *J Am Med Ass.*, 1947 134 1143

Army and Navy medical missions studied the results of the explosions of the atomic bombs in Hiroshima and Nagasaki, Japan. The two most impressive features of the investigation were the tremendous toll of casualties and the syndrome due to large amounts of gamma radiation. One-sixth of the casualties were crushed under buildings or were trapped in burning buildings and died instantly from the direct heat of the bomb. About one-seventh of the casualties showed no injury on the day of the explosion but received sufficient gamma rays to become sick 1 to 5 weeks later. By rough estimate about 85,000 persons in Hiroshima and 50,000 persons in Nagasaki required medical care on the day of bombing. The types of injuries that required treatment resulted from the characteristic products of the bomb which are (1) mechanical energy "blast" (2) heat (3) light, and (4) ionizing radiation. These injuries could be classified as wounds, 70 per cent burns 65 to 85 per cent, and radiation more than 30 per cent.

It was impossible to estimate the amount of radiation that any one person received. However it is certain that the intensity of the gamma rays varied with the distance from the bomb by the law of the inverse square and it is also evident that heavy buildings and underground shelters gave more protection than wooden structures and open space.

Those who received the largest amount of radiation developed fever and diarrhea the next day, purpura in 4 to 7 days and then rapidly failed and died. Autopsy findings were those of purpura hemorrhagica with petechiae, gastrointestinal erosion and disappearance of normal lymphocytes and marrow cells.

Most patients developed symptoms between 7 and 28 days after the bombing and this syndrome consisted of epilation, intractable diarrhea, purpura, fever, leukopenia, and anemia. The complications were those found in agranulocytic angina. The loss of hair was rarely complete and in most patients it began to grow again in 2 or 3 months. Leukopenia was the outstanding laboratory finding and recovery was rare when the total count dropped below 600 per cubic millimeter. It is estimated that the mortality in this group was between 50 and 75 per cent.

The least severe form of this syndrome appeared from 3 to 5 weeks after bombing and consisted of weakness, malaise, diarrhea, and mild inflammation of the mouth and throat. Some patients developed epilation. Anemia was constant and often progressive. There was mild leukopenia and thrombocytopenia. The bone marrow was badly damaged but in

most cases showed some evidence of regeneration within 7 to 10 days after injury. Spermatozoa were absent from the tubules of the testes in the majority of the men who received enough radiation to cause symptoms.

The therapy of patients with radiation injury should be directed to (1) maintain fluid and electrolyte balance (2) control infection (3) combat hemorrhagic tendency and (4) combat anemia.

ROBERT MAYO TENNEY M.D.

Melkersson's Syndrome: A Report of 5 Cases, with Special Reference to the Pathologic Observations. Karsten Kettel. *Arch. Otolaryng.*, Chic. 1947 46 341

Melkersson's syndrome is a characteristic facies morbi comprising the following triad: chronic swelling of the face, peripheral facial palsy, and lingua plicata. As a rule the disease begins in childhood or youth with an attack of peripheral facial palsy which may be bilateral and may show a tendency to relapse. Either simultaneously or later (sometimes not until several years later) a swelling of the face occurs, which is especially localized to the lips. The tongue is distinctly furrowed (lingua plicata). The syndrome is characteristic. In the acute stage the disease has been mistaken for erysipelas; in the chronic stage it has been mistaken for acromegaly. Both clinically and pathologically, anatomically the facial palsy shows a close correspondence to Bell's palsy.

In fresh cases the patient should be observed for about 2 months. If there are no signs of beginning mobility after that period decompression of the facial nerve should be performed in accordance with the Ballance-Ducl method. Moreover the same treatment is indicated if the spontaneous mobility has ceased before complete restitution has been obtained and in case of relapsing palsy.

The author presumes that the vasomotor fibers of the face follow a shorter or longer course in or along the facial nerve. Paralysis of the sympathetic fibers involves both paresis of the vascular supply of the facial nerve, resulting in facial palsy and paresis of the vessels of the face followed by edema.

C. FRED GOERNOWITZ, M.D.

A Plastic Operative Procedure for the Repair of Large Circular and Elliptical Body Surface Defects. Boyan Hadjilastamoff. *Plast Reconstr Surg* 1947 2 362

Large circular or elliptical body surface defects are formed chiefly after the removal of malignant tumors, excision of old atonic wound surfaces, and function-hindering scars. After certain injuries there also occurs extensive circular loss of substance which may require normal skin covering.

In the majority of cases the easily performed Thiersch-Reverdin graft may be done. In other



FIGURE 1 (Continued)

ages, and the red, the white, and the yellow. The new contracture of the closure must be effected with minimal skin.

The closure of the wound which is accomplished at one sitting through a flap has the great advantage of being quick and less painful.

The author describes a procedure for dealing with large circular or elliptical defects in which he utilizes neighboring skin and attributes the repair to it.

Considering the local blood supply to the flaps, the author makes a quadrangular (TAB=a) and a triangular (TAB=b) flap. The incision is required to be at least one (AB) inch from the incision line and more or less parallel to the edge of the defect. The old quarter incision (AB) amount appears to be the radius length of the circular defect. The width of the flap (a) should be at least one half to two thirds of the width of the defect. The flaps are mobilized and pulled over the defect. There still remains three unincised areas which are closed by suturing the adjacent skin edges.

This procedure has been successfully applied to three regions of the body—upper humerus, upper back, and ischial and trochanter regions.

LOUIS T. RYAN, M.D.

The Blood Circulation in Pedicle Flaps. Preliminary Studies on a Photo-Electric Test for Determining Its Efficiency. Beverly Douglas and Glenn A. Millikan. *Plast Reconstr Surg* 1947; 1:345.

The present test, in which the authors employ an apparatus developed during the war for measuring continuously the oxygen saturation of arterial blood in man, represents a method of determining the viability of

flaps of tube flaps. The adequacy of circulation is estimated from the period with which blood enters the flap following the release of a tourniquet. The blood content of the flap is measured photoelectrically by a simple modification of an oximeter ear unit. The present method measures only changes in the total amount of blood in the flap. It cannot distinguish between the efficiency of arterial supply and venous drainage. The rapid return of blood to a previously "milked" flap after releasing the tourniquet indicates a good arterial supply but tells us nothing about a leakage of venous drainage. Decreased blood content following release of the tourniquet indicates inefficient venous drainage.

The oximeter ear unit consists of a U-shaped structure bearing a small incandescent lamp on one leg and a photocell assembly on the other.

For the present experiment the unit has been modified to fit on flaps of different thicknesses without any alteration in blood circulation.

Upon releasing the tourniquet around one end of the previously "milked" flap, while the other is kept on, blood enters the flap and the resultant flush reduces the transmission of light. This change can be followed continuously by the lamp on one side of the flap and the photocell on the other.

A typical test consists of applying tourniquets at each end of the tube. The circulation is cut off by tightening the tourniquet at one end; the flap then presses free of blood. Without allowing a return of circulation, the other tourniquet is tightened and the oximeter adjusted. The pressure of the tourniquet at one end is then quickly removed and readings are taken at 5 second intervals for 2 or 3 minutes.

The oximeter test offers a very rapid method of testing the efficiency of pedicle flaps. Predictions of

successful transfer based on the test have been justifi-
fied in all 8 cases in which it has been applied. Since
flaps may safely be transferred as soon as the ox-
imeter test gives evidence of adequate circulation con-
siderable time may be saved between operations.
Preliminary experiments indicate that the photo-
electric method can also be applied to the study of
metabolic as well as circulatory changes in pedicle
flaps, and in small extremities.

LOUIS T. BRADY, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Fluid Blood in Doubly Ligated Vascular Segments
as a Result of Thrombolysis (Flussiges Blut
durch Thrombolysen in doppelt unterbundenen Ge-
fäßstücken) M. Zehender *Illust. chir. sci.*
1947 14 162.

Two theories have been advanced to explain the
presence of fluid blood within ligated vascular seg-
ments. According to one theory there is an inhibi-
tion or breakdown of coagulating substances as in
carbon monoxide poisoning and asphyxia. The other
explanation as confirmed by the present experi-
ments is thrombolysis or autolytic fibrinolysis. The
Baumgarten experiment of double ligation of the
parts of such vessels as the vena cava, jugular vein
saphenous vein and common carotid artery was
repeated in rabbits, horses, and sheep the condition
of the stagnant blood between the ligatures being
examined at different intervals with modern coagu-
lation tests. In early specimens (taken after 3 days
a firm gelatinous coagulum was found after 3 days
specimens consisted of fluid blood. This fluid blood
did not coagulate spontaneously nor after the addi-
tion of thrombin. A complete lack of fibrinogen sub-
stances was demonstrated. Addition of hemophilic
blood containing fibrinogen caused instantaneous
coagulation. The number of blood platelets in the
fluid blood was also diminished and in later speci-
mens the blood platelets had disappeared altogether.
It is suggested that the blood platelets and fibrin
fluid blood within doubly ligated vascular segments
must be liquefied autolytically or thrombolysed blood
Analogous conditions were demonstrated clinically
in a case of subdural hematoma containing
fluid blood. An increased fibrinolytic titer was de-
monstrated in the circulating blood of a patient with
hematomas of the soft tissues. It is therefore prob-
able that local autolysis of the coagulum is associated
with a general fibrinolysis of the coagulum of local auto-
lysis or thrombolysis in bland thrombophlebi-
tis of the axillary veins and secondary hemorrhage
monstrated in a similar manner the secondary
hemorrhage in traumatic rupture of the spleen and
the intermittent paralysis of cranial nerves following
basal fracture as being due to autolytic changes in

thrombi and coagula. Liquefaction of subdural he-
matomas occurs in a similar manner.
The increase of fibrinolytic power in the circula-
ting blood following the occurrence of hematomas
might also explain the effect of autogenous and foreign
blood injections on the consolidation of pneumonia
(fibrinous coagulation within the pulmonary alveoli).

EDITH SCHWARTZ MOORE.

EXPERIMENTAL SURGERY

**Vascular Reactions during Experimental Hemor-
rhage** Nervous and Humoral Factors of Post
hemorrhagic Peripheral Vasoconstriction in the
Dog (Sur les réactions vasculaires au cours de l'hé-
morrhagie expérimentale. Les facteurs nerveux et
humoraux de la vasoconstriction périphérique post-
hémorragique chez le chien) Leon Binet and M.
Burstein. *Rev. Méd.* 1947 3 168.

As the result of a new perfusion technique, the
authors have been able to study the tonus of the
peripheral vessels in experimental hemorrhage. The
decrease in the blood mass even in cases in which the
resulting hypotension is very slight, produces an
intense peripheral vasoconstriction. This reaction
is essentially of central origin and conditioned by
the increase in tonus of the vasoconstrictor centers
however during the hemorrhage the blood acquires
vasoconstrictor properties. The vasoconstriction is
discharge of adrenalin. Probably because of a
immediate it is weak in those animals which stand
the bleeding poorly and very marked in the opposite
types. It is suppressed by section of the 4 inhibiting
nerves. The degree of anesthesia of the animal also
plays a part. The vasoconstriction may be absent
after a massive or very sudden hemorrhage. In such
a case partial restitution of the blood mass may allow
The posthemorrhagic vasoconstriction may allow
appear because of exhaustion of the centers or fol-
lowing ischemia. It is easy to depress the tonus of
the vasoconstrictor centers which are stimulated by
hypotension.
Increasing the blood mass acts in the opposite
direction and causes a peripheral vasodilatation.

RICHARD KEMZ, M.D.

Intravenously Administered Gelatin—A Toxicity
Study Milton J. Vander Brook, Stanley C.
Lyter, Boyd E. Graham, Noel E. Pomeroy and
George P. Cartland. *J. Lab. Clin. Med.* 1947 33
1115

A highly purified 5 per cent gelatin solution, pre-
pared especially for intravenous therapy in human
beings was well tolerated by dogs when given re-
peatedly for several weeks in amounts commensurate
with the fluid lost by hemorrhage.
The only morphological pathology which might be
attributable to gelatin in this series of experiments
was the presence or increase of sudanophile droplets
in the Kupfer cells. The significance of such a change
is not known. The function of the Kupfer cells was

apparently not altered. None of the dogs developed infection of the respiratory tract or at the sites of bleeding and infusion.

Only the sedimentation rate was altered by gelatin. This phenomenon is common to all macromolecular substances, and occurs also when plasma protein concentration is elevated. Gelatin does not interfere with the formation of hemoglobin or plasma protein, both of which are partially depleted by hemorrhage when infused weekly for periods as long as 3 months.

Gelatin does not appear to be stored in the liver or kidneys. A major portion is excreted by the kidneys. The fate of the balance is unknown.

SMITH, F. M. & M. H.

Experimental Production of Ulcers in Closed Gastric Pouches in Dogs. F. F. Stein, Jr., M. I. Grossman and A. C. Ivy. *J. Surg.* 66: 32-35, 1932.

The authors attempted to elucidate the role which acid-pepsin plays in ulcer production and to ascertain if continuous exposure of gastric mucosa to normal gastric juice would result in ulcer formation. For this purpose they utilized healthy mongrel dogs weighing from 25 to 35 pounds.

In the first group of 5 dogs a portion of the greater curvature of the stomach comprising one third to one half of the fundus was resected according to the Heidenhain technique, but the resected segment was completely sutured into a closed pouch. A clamp was used for the remaining gastric portion.

In the second group of 8 dogs a two-stage procedure was employed, the first being the construction of the usual Heidenhain pouch. After from 9 to 12 days the dog was reoperated upon and the stomach of the Heidenhain pouch was fully sutured in 2 layers, thus creating a closed gastric pouch.

In the third group of 6 dogs primary closure was established as in Group 1, following which an ulcer region of the middle or inferior end of the pouch was attached to the parietal peritoneum underlying the second left nipple which was used as a point of localization. Twenty-four hours later, a 15 gauge needle was inserted through the abdominal wall into the pouch, a pressure determination was made with a water manometer and gastric juice was collected to relieve pressure and also for titration. Late readings were made every 12 to 24 hours.

All 5 dogs in the first group died in 2 to 3 days of acute ulcer formation with perforation and peritonitis.

Four of the 8 dogs in the second group died of acute ulcers with peritonitis in 3 to 8 days following closure of the stomach. One dog which was sacrificed 20 days after closure of the stomach showed a grade of tenfold pouch without pathologic changes. The remaining 3 dogs died of recurrent ulcers without ulcer.

Four of the 6 dogs in the third group died in 7 to 20 days of acute ulcer of the pouch with perforation and acute peritonitis. The remaining 2 dogs died on 13 and 24 days from extraneous causes without pathologic changes in the pouch. All the animals had a free acid concentration of over 300 mEq per liter but acute ulcer of the pouch with perforation.

In the majority of cases acute ulcers with perforation developed in closed Heidenhain gastric pouches. Clinically conditions approaching those encountered in a closed pouch are found in pyloric stenosis, the increased pressure and increased secretory activity often present in this condition may predispose to extension of perforation of an ulcer.

R. BERT TRIVETT, M.D.

SURGERY

GYNECOLOGY AND OBSTETRICS

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THE CYTOLOGIC METHOD AS AN AID IN THE DIAGNOSIS OF GASTRIC CARCINOMA

RUTH M. GRAHAM, B.S. HOWARD ULFELDER, M.D. and THOMAS H. GREEN, Jr., M.D.
Boston, Massachusetts

CARCINOMA of the stomach is encountered more frequently than is any other malignant lesion today. Surgical extirpation has been the only effective means of treatment but the disease is so insidious in its onset that extirpation is rarely possible. Pack and Livingston in 1940 made the statement that, at no time in surgical history and at no point in the world have the definitive cures of gastric cancer ever exceeded 5 per cent of the total number of cases with this disease. In 1942 Walters, Gray, and Priestley reported 6.2 per cent 5 year cures in a series of 10,890 cases. Abrahamson and Hinton in a recent paper state that only 5 per cent of their 139 cases of gastric cancer could be considered candidates for cure. Welch and Allen at the Massachusetts General Hospital have found 6.5 per cent of 375 patients surviving at the end of 5 years. It is obvious that although gastric surgery has grown steadily more radical and less hazardous the rate of cure remains low.

Cancer of the stomach is usually moderately advanced before it produces any symptoms at all. If any significant increase in the rate of operability with expectation of cure is to be achieved we must devise some means of detecting the disease in its presymptomatic state. One such effort was reported in 1944 by

St. John Swenson and Harvey. Using a technique of rapid fluoroscopic scanning of the stomach, they discovered three malignant gastric tumors in 2,413 individuals over the age of 50 years. None had digestive symptoms of clinical note. Five other patients were explored and benign ulcers were found.

We are presenting in this paper a preliminary report on our experience with another diagnostic measure which may be of value in discovering early gastric carcinoma—cytologic examination of gastric fluid for the presence of malignant cells.

The cytologic method in the diagnosis of carcinoma was introduced by Papanicolaou in 1928 (7). The method depends on the observation that most malignant growths desquamate cells which can be identified after suitable fixation and staining. The original report dealt with uterine carcinoma and has been confirmed by many investigators (2, 5). It was an obvious step to apply the cytologic method to other body fluids. In 1937 Dudgeon and Wrigley reported 66 per cent accuracy in the diagnosis of cancer of the lung by examination of the sputum. Wandall in a series of 100 pulmonary carcinomas found malignant cells in the sputum of 86 per cent. Papanicolaou in 1945 (9) mentions 9 patients in whom the gastric secretions obtained by aspiration were studied. Two had gastric carcinoma and malignant cells were seen in the gastric fluid.

From the Vincent Memorial Hospital Laboratory of the Massachusetts General Hospital, Boston, Massachusetts.

In the past year at the Vincent Memorial Laboratory gastric aspirations from 50 patients suspected of cancer of the stomach were studied by the cytologic technique.

METHOD

1. A fasting specimen of gastric secretion is obtained by a siphon. In this series gastric aspirations were used rather than gastric washings. It is of the utmost importance that the specimen be sent to the laboratory immediately since if there is more than half an hour's delay the cells are digested and no distinct cellular characteristics can be identified.

2. The specimen is centrifuged immediately, the sediment spread on a glass slide and placed at once in a fixative of equal parts ethyl ether and 95 per cent alcohol.

3. After fixation for at least 15 minutes the slides are stained by Japanese method (8).

CYTOLOGY OF GASTRIC SECRETION

Normal cells. Most of the cells normally encountered in the gastric secretion originate in the squamous mucous membrane of the upper gastrointestinal and pulmonary tract. These are large epithelial cells with a clear cytoplasm and a small vesicular nucleus. Often epithelial cells from the gastric mucosa are seen. These appear as cuboidal or columnar cells with an eccentric nucleus which is small and vesicular. Occasionally these columnar cells are flattened and then they appear as great sheets of cells with nuclei of even size and single nucleoli. If the cells are well preserved cellular borders are distinct. If the cell group has undergone some degeneration the cytoplasmic outline may disappear although the nuclei remain sharply defined.

Erythrocytes, neutrophils, lymphocytes and histiocytes are usually seen. Bacteria are common and cocci in groups of four are noted fairly frequently.

Malignant cells. The malignant cells seen in gastric secretion often appear in groups. They have nuclei which are hyperchromatic and usually contain prominent nucleoli. There are no sharp cellular borders. Often the cytoplasm shows vacuolization, a characteristic of adenocarcinoma. There are occasional single

cells which can be identified as malignant. They have large hyperchromatic nuclei and an inadequate amount of cytoplasm.

RESULTS

In this series of 50 cases 24 had carcinoma of the stomach. Cancer cells were seen in the gastric fluid of 15. The error in the positive cases is 37.5 per cent.

All 24 of these patients were explored. Seven of the lesions were resectable and 5 of these had previously shown malignant cells in the gastric secretion. One of the two failures in this small group was a scirrhous carcinoma of the wall of the stomach without ulceration of the mucosa. Such a tumor could not be expected to shed cells into the gastric lumen.

In 26 cases no evidence of cancer was shown. Fourteen patients were explored. Twelve were proved to have benign gastric ulcers, 1 had a neurofibroma of the stomach and 1 a benign duodenal ulcer. The gastric cytology was correctly diagnosed as negative in 25 instances. One positive cytological report was rendered in a case later proved to have a benign gastric ulcer. The error in the benign cases is 3.8 per cent.

Below are abstracted two cases which illustrate the value of the method.

PR. MCH. No. 521265. This 50-year-old man entered the hospital with the complaint of cramping postprandial mid-epigastric pain of 14 months duration. He had obtained relief for the first 3 months on liberal low fat bland diet and antacid medication. The symptoms had then recurred. He had lost 5 pounds in weight over the course of a year but had noted no blood in his stools. Gastric analysis showed 0 free acid in the fasting specimen, there were 27.0 units in the first sample after histamine. Gastrointestinal x-ray examination showed marked spasm of the antrum, probably due to a benign ulcer in the middle third of the lesser curvature. Cytologic examination of the gastric fluid was positive. A subtotal gastrectomy was performed. Pathological examination of the specimen showed a gastric ulcer with multiple foci of carcinoma in situ. Further section revealed one area of invasive growth with penetration beneath the muscularis mucosa and involvement of nerve and nerve sheath. The lymph nodes were negative.

H.S. MCH. No. 521291. This 67-year-old man entered the hospital with the complaint of intermittent severe upper abdominal and substernal pain occurring 1 to 2 hours after eating. He had not vomited and had noted no blood in his stools. He had

lost 20 pounds in weight. *Gastrointestinal x-ray examination* showed an ulcerative lesion (2.5 by 1.5 cm.) in the upper stomach which could be either malignant or benign. *Cytologic examination of the gastric fluid* was positive. A transthoracic total gastrectomy was performed. *Pathological examination* of the specimen showed a benign gastric ulcer. The lymph nodes were negative. These sections were reviewed and one area of preinvasive carcinoma was found at the periphery of the ulcer.

DISCUSSION

Any approach which promises to bring cancer of the stomach to operation sooner than in the past merits attention. Mass radiography is one avenue of attack. We feel that the cytologic method may also be of great value in this problem. Although 9 of the 24 cases of carcinoma in this series were erroneously called negative on cytologic examination only 2 of the 7 resectable cases were missed and 2 extremely early cases were both diagnosed correctly. The observation that preinvasive carcinoma sheds cells which can be recognized as malignant is of fundamental significance. This fact has already been noted in carcinoma of the cervix (4). The increased accuracy of the cytologic method in early lesions may be due to the presence of active healthy malignant cells on the surface of such lesions. In the advanced tumor with ulceration and necrosis only occasional recognizable cells may be desquamated. Since our primary endeavor is to seek out the earlier cases these facts emphasize the value of the cytologic method.

SUMMARY

1. The cytologic method of diagnosis has been applied to gastric aspiration in 50 patients with gastric symptoms.

2. A description is presented of the normal and malignant cells which are noted in gastric fluid.

3. Of 24 patients proved to have carcinoma of the stomach smears were positive in 15 instances.

4. Of 7 patients with resectable lesions of the stomach smears proved to be positive in 5 cases.

5. Of 26 patients without cancer the smear was reported positive in 1 a man with a benign gastric ulcer.

6. Two patients had extremely early malignant lesions. In both the lesions were detected by the cytologic technique.

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THE SYNDROME OF OVARIAN PAIN AND INSUFFICIENCY

The Importance of Conserving Ovarian Tissue

GEORGE P. HECKEL, M.D., Rochester, New York

UNLESS it occurs regularly at the time of ovulation ovarian pain is likely to be overlooked or misdiagnosed. Thus cyclic ovarian pain or *Mittelschmerz* described long ago by German gynecologists and more recently believed to be associated with ovulation has been generally recognized but the irregular pain of ovarian origin in the absence of demonstrable pelvic disease has not been considered. It is the purpose of this paper to show by the review of carefully observed cases an association of ovarian pain with ovarian dysfunction and to indicate partly by analogy with known reactions of the ovary in animals the possible mechanism of the ovarian failure.

Obviously if there is any possibility of an association of ovarian pain and ovarian insufficiency ovarian tissue should be conserved. It would seem redundant to say that ovarian tissue should be saved for no one would hold that any tissue should be removed unless it is abnormal or useless and potentially abnormal. But the protean nature of the ovary makes it subject to mutilation and removal by those unfamiliar with ovarian physiology and pathology. Graafian follicles and corpora lutea varying greatly in size are all too frequently mistaken for cysts and innocuous cysts of the follicle or corpus luteum resulting perhaps from a temporary upset in the endocrine mechanism lead to the removal of the entire ovary. Many women suffer no ill effects from unilateral castration but there are others in whom there appear signs of ovarian failure. If pain to the ovary because of which perhaps the ovary was removed was associated with ovarian insufficiency in the intact woman loss of half of her already inadequate ovarian tissue will make matters

worse. Pain may develop in the remaining ovary and such symptoms of ovarian insufficiency as she may have had are sure to be aggravated. The inadvisability because it is unnecessary of removing small ovarian cysts has been pointed out (13) and the dangers of this procedure have been noted (9). The possible implications of the removal of ovarian tissue can be realized only when one considers the known reactions of the ovary in animals to experimentally induced ovarian insufficiency.

It is known that in animals which have had one ovary removed the remaining ovary increases in size and sheds a greater number of ova. Beyond a certain point however removal of ovarian tissue results in disturbed ovarian function. If much more than half of the ovarian tissue is removed, that is one ovary and part of the second, failure of ovulation and cystic changes result (to 11). A certain mass of ovarian tissue probably varying in different individuals must be present in order for it to hypertrophy adequately and restore the disturbed endocrine balance.

It is apparent that in the woman removal of one ovary results in the increased activity of the remaining one for the menstrual cycle is not usually altered by the operation. The remaining ovary almost immediately does the work formerly accomplished by two. It is not so apparent however and not generally recognized by clinicians that the remaining ovary increases in size while performing the added function. It is also not realized by many who remove ovarian tissue that there is a limit to the amount that can be removed beyond which seriously disturbed function associated with cystic changes occurs. The following case is illustrative.

ILLUSTRATIVE CASE. When this 25 year old woman was first seen she complained chiefly of persistent vaginal spotting for the past 20 days. Menstruation, regular until the present episode had begun at the age of 15.

From the Department of Obstetrics and Gynecology, The University of Rochester School of Medicine and Dentistry. Presentation of part of this material was awarded the Palmer Drug Company Prize of the Rochester Academy of Medicine in 1944.

She had been married 3 years, there were no pregnancies.

Two years previously she had a right salpingo-oophorectomy because of pain in the right lower quadrant of the abdomen. Two years before that she had had an appendectomy because of similar pain. Four months before she was first seen her left ovary had been resected.

Physical findings were negative. During the next 2 weeks, the patient began to experience hot flashes. The spotting which increased gradually in amount stopped after a total duration of 38 days. Spotting recurred 10 days later and it was followed in 2 weeks by a profuse menstruation.

The diagnosis and findings at the first operation when the right ovary was removed could not be learned, but examination of the hospital record covering the second operation 4 months previously when part of the remaining ovary was removed revealed that the operation was done because of a supposed mass on the right side which proved to be caused by postoperative adhesions. The left ovary was described as 3 to 4 times the normal size. Apparently because of this enlargement two-thirds of it were resected. Examination of the slides prepared from the tissue removed revealed entirely normal ovarian tissue including many graafian follicles and a fresh corpus luteum. The loss of ovarian tissue was progressive. With one ovary apparently normal function continued and the ovary increased in size. Unmistakable signs of failure followed further reduction of the ovarian tissue.

This case illustrates for the woman the condition which has been called *extreme partial castration*. In the woman as in animals, ovarian fragments may not be able to assume the function of the original ovarian mass.

The importance of growing follicles for normal ovarian function has been demonstrated in the rabbit. Westman (24) and Westman and Jacobson (25, 26, 27) have shown that an adequate amount of estrogen produced by the growing follicles is necessary for the occurrence of ovulation and formation of the corpus luteum; that the life of the corpus luteum is dependent upon estrogen, and that these effects are independent of the hypophysis indicating a direct effect on the ovary. In Westman's experiments when all but one of the graafian follicles were destroyed, ovulation did not occur in that one even in the presence of a sufficient quantity of gonadotrophic hormone. But when estrogen was added ovulation occurred and a corpus luteum was formed. In view of this action of

estrogen in experimentally induced ovarian insufficiency in the rabbit it would seem reasonable to treat with estrogen ovarian insufficiency in young women with the purpose of improving the function of the ovaries in spite of the widespread opinion that the hormone produced by the ovary itself has no direct effect on it. The ovary is peculiar in that it represents two endocrine glands having their maximum activity at different times. The graafian follicles which produce one hormone, estrogen, are followed in the cycle by the corpus luteum which makes another, progesterone.

Westman's experiments indicate that the corpus luteum is dependent on the production of estrogen by the follicles throughout the cycle. The amount of estrogen given and the timing of the administration would be important in therapy aimed at improvement of ovarian function in the woman for it is known that the hormone given in sufficient amount early enough in the cycle will inhibit ovulation, presumably by suppressing the gonadotrophic activity of the hypophysis (21).

The cases to be presented below are divided into 3 groups for analysis. In the first group ovarian tissue had been previously removed in most instances because of pain in the lower abdomen. Pain recurred following operation and when the patients came under observation of the author its source could be identified as the ovary. In the second group the patients were observed before any surgery was performed. In all of them careful observation revealed the ovary to be the source of the pain and in none was it of sufficient cyclic regularity to be classed as *Mittelschmerz*. Cases of cyclic intermenstrual pain or *Mittelschmerz* comprise the third group.

The frequency with which signs of ovarian insufficiency were associated with ovarian pain suggested that the latter is part of a syndrome of ovarian insufficiency. When looked for pain and excessive tenderness of the ovary were found frequently enough to be considered criteria of this condition. The beneficial effect of estrogen in the treatment of many of these cases strengthened this impression and the relief of *Mittelschmerz* without suppressing ovulation illustrated by the cases in group 3.

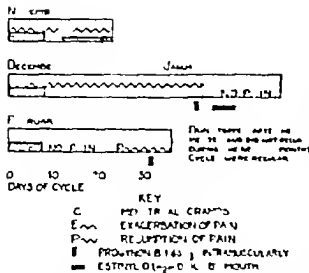


Chart K.M. 30 year old woman. Large irregularities before menstrual cycle, small irregularities after removal of ovarian tissue.

supports the theory that the human ovary, like that of the rabbit, requires the estrogen produced by the growing follicles for completion of the cycle of follicular growth, ovulation and corpus luteum formation and survival and the quantity of estrogen and hence the amount or mass of ovarian tissue is of the greatest importance.

Group 1. Ovarian insufficiency and pain following loss of ovarian tissue. There are 15 patients in this group, none of whom was permanently benefited by the removal of ovarian tissue. Pain recurred in all and 13 of them experienced other symptoms of ovarian failure after operation. Pain was relieved by estrogen in most of the cases in which it was tried, 10 out of 11. One case considered the most typical is described in detail.

K.M. This 30 year old woman began to have recurrent pain in the right lower quadrant of the abdomen at the age of 12, about a year after the menarche. It was frequently associated with nausea and vomiting and 3 years later an appendectomy was done because of it. Attacks of pain continued. She was first seen in the Out Patient Department at the age of 15, about 8 months after the operation. Menstruation 4 days were at 28 day intervals. Findings were normal except for abdominal tenderness in the right lower quadrant. The introitus was normal and the hymen was intact. At this time the pain was irregular, described as sharp and shooting, occurring several times a week and lasting as long as a day. During the next 8 years intermittent pain con-

tinued but was less troublesome. She married and at the age of 22 had a normal pregnancy with a normal infant. Seen again about a year after birth of the child, she again complained of pain in the right lower quadrant, now beginning 2 days after the cessation of the menses. Menstrues were at 24 to 28 day intervals lasting 4 to 5 days without dysmenorrhea. Examination revealed ovaries of normal size, the right one usually tender. Three months later the left ovary was more tender and 3 months after that the right ovary was again described as the more sensitive.

At no time was there any evidence of infection. She was not seen again in this clinic until 5 years later. She now complained of pain on the left side and reported that 3 years before, 2 years after her husband's death, her right ovary had been removed at another hospital because of the pain previously complained of. After the operation she began to have irregular bleeding and she experienced hot flashes. She began to have menstrual cramps for the first time. About 6 months after the ovariectomy the pain in the other ovary began. Inquiry revealed that exacerbations of the pain in the left lower quadrant occurred in about mid-cycle along with bleeding. This pain was present most of the time, however, and in the acute phase it radiated down the left thigh across the pelvis into the upper left leg and the lumbar area on the left. Examination was negative except for the extreme tenderness of the left ovary estimated to be 3 centimeters in diameter. The anamnesis during 4 months in this case is shown graphically in Chart 1.

Examination of the right ovary removed 3 years before revealed normal ovaries to size.

Reactions like those illustrated in this group of cases have been observed by Karmakar. He mentions 89 cases in which irregular menstruation, bleeding and pain in the left ovary followed removal of the right ovary at the time of appendectomy.

Group 2. Irregular ovarian pain. The 15 patients in this group all experienced pain in one or both lower quadrants of the abdomen for periods ranging from 2 weeks to 10 years. Increased tenderness of the ovary or in the region of the ovary on the affected side was demonstrated in all. In none was there any evidence of abnormal ovarian enlargement or adnexal disease. Both ovaries were palpable in 36 cases. In 19 only one could be felt and in 20 neither one could be outlined. In 9 cases it was possible to check the findings at laparotomy.

The onset of pain occurred as early as the ninth and as late as the thirty-eighth year. The largest number of patients, 35, first ex-

perienced pain in the third decade. Twenty six first noticed pain between the ages of 10 and 20. Onset occurred in the fourth decade in 13 cases. One woman of 21 began having recurrent pain before puberty at the age of 9 years. In 9 cases the pain was cyclic at first and later became irregular. One of these, operated upon in an early attack of pain in the right lower quadrant was found to have intraperitoneal hemorrhage from a ruptured graafian follicle. This was the only patient of those subjected to laparotomy in whom this condition was found. Suture was not necessary, and the ovary was left alone. Irregular pain began during the following year.

Signs or symptoms of ovarian insufficiency were present in 59 cases. Hot flashes occurred in 27 cases, intercytic bleeding in 19, abnormally irregular cycles (2 weeks to 2 or 3 months) in 16, menorrhagia in 12, hypomenorrhea in 9, and amenorrhea in 3. Thirty six patients had one of these symptoms: 19 had 2 and 4 had 3. Sixteen patients had none. The pain was classed as slight in 7 cases and as moderate to severe in 68. In 9 of the latter group with severe pain laparotomy was done. There were other signs of insufficiency in all of these: 6 had 1, 2 had 2, and 1 had 3. Three of the 7 patients with slight pain had amenorrhea, 1 had irregular cycles.

Pain occurred most frequently on the right side. In 46 of these 75 cases it was exclusively on the right. In 7 it was experienced only on the left. Either side (one side for a time and then the other) or both sides were involved in 22 cases. Of these the right was the more troublesome in 19, the left in 3.

Fifty-eight patients had menstrual cramps of varying severity. In 21 cases the ovarian pain was aggravated at the time of the menses. In 50 cases it was not, and in these the pain was likely to be less troublesome during menstruation.

Thirty six patients experienced radiation of the pain into the thigh on the affected side. More may have had this symptom for the information was not always volunteered when the pain was not severe, and in the early cases patients were not questioned concerning it. The pain was not well localized. Except in severe cases where it radiated to the foot, it usually did

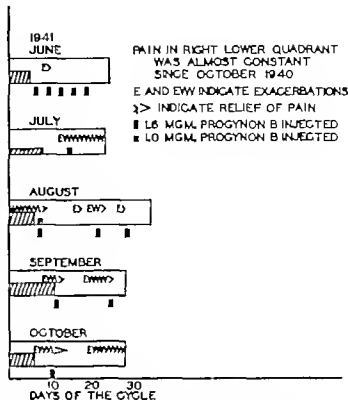


Chart 2. M.M. Large rectangles indicate the menstrual cycle; small shaded rectangles, the menstrual flow.

not extend beyond the knee. It is of interest that radiation into the thigh of pain of ovarian origin was noted 70 years ago (6). In 10 patients pain seemed to radiate to the back in the sacroiliac region of the affected side.

Two cases of irregular pain are reviewed in detail. The first is one of acute onset of pain in a young woman. The pelvic organs were examined at laparotomy and a biopsy of the painful ovary was obtained, but long term follow up was not possible.

D.S. This 30 year old woman complained of intermittent, and at times incapacitating pain in the right lower quadrant of the abdomen for the past 10 days. Her last menstrual period occurred 2 days after the pain began and lasted one day. The pain became worse after the one day flow, and at the time she was first seen it was almost constant. Her appendix had been removed.

Menarche at 12, her periods had been of 3 days duration at 18 day intervals until 3 months before when they became shorter, only 1 day, and were accompanied by more pain, consisting of lower abdominal cramps. General examination was negative except for tenderness in the right lower quadrant. Pelvic examination revealed a very tender mass the size of a normal ovary on the right side. Rabbit ovulation test for pregnancy was negative.

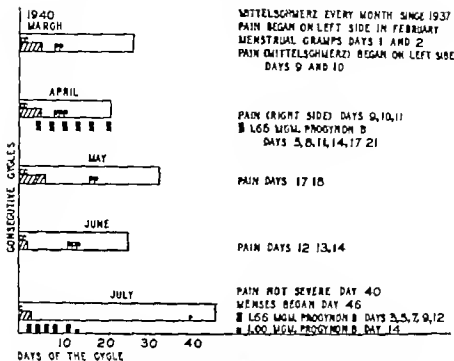


Chart 3. Case of F.S.

Because of the negative findings, the patient was observed. The pain, however, became more severe, and on examination a days later the mass on the right, thought to be ovary was more tender so much so that operation was decided upon.

At operation the pelvic organs were found to be normal in appearance. The right ovary larger than the left, and apparently the mass which had been felt on examination, was not over 5 centimeters in its greatest diameter. It appeared tense however and on incision several follicles were found in the central portion. The largest of these were carefully resected and the incision was closed with fine catgut. No corpora lutea were identified in either ovary.

Histological examination of the tissue removed showed normal ovarian tissue including cellular stroma, the walls of several graafian follicles, and part of a corpus albicans.

There was no recurrence of pain during the 3 weeks following operation.

This case is the type in which one ovary the apparent source of incapacitating pain, is likely to be removed.

In the following case operation was avoided in an early acute attack of pain. The subsequent course over a period of 2½ years is summarized.

M. M. This unmarried woman was first seen in 1941 at the age of 22. She had experienced recurrent attacks of pain in the right lower quadrant of the abdomen for 3 months. The first attack occurred

midway between two menstrual periods and was accompanied by scant bleeding of 3 days' duration. The next attack, a month later was unaccompanied by bleeding. It was of such severity associated with nausea, that appendicitis was suspected. Vital signs were normal however and the classical signs of appendicitis were lacking. Since then, attacks had become more frequent, and she had almost constant soreness in the right lower quadrant, aggravated by walking. For the past 3 days, there had been scant vaginal bleeding which had begun 2 to 3 weeks after the last menstrual period. She complained also of some pain in the right sacroiliac region.

The menarche had occurred at the age of 14, and periods had been irregular, 14 to 35 days, lasting 8 to 10 days. She always experienced crampy pelvic pain during the flow preceded for a few days by aching in the right lower quadrant like the pain of which she complained. The flow was often extensive and she frequently remained in bed during the first day. General physical examination was negative. On pelvic examination, the right ovary was found to be markedly tender although within normal limits of size. Basal metabolic rate was -13 per cent. The patient was observed during the next 3 years, during which pain was intermittent and menstrual irregularity persisted. Treatment consisted principally of small doses of thyroid over long periods and injection of estrogen 1 or 1.6 milligrams of progyron B at various times during the cycle. Injections were almost always followed by relief of the pain, at times for as long as a week, but usually for a day or two. On more than one occasion, when the estrogen was given frequently in the early part of the cycle, men-

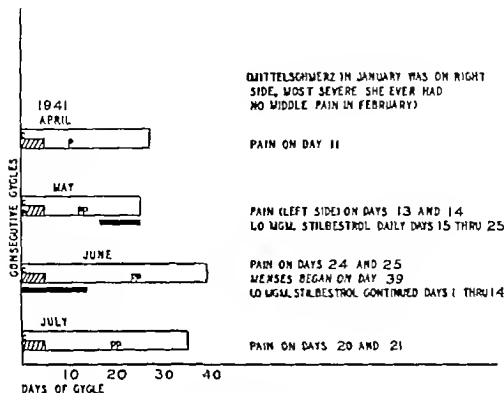


Chart 4. Case of F.S.

strual cramps were abolished indication that ovulation had been suppressed

Typical responses of the ovarian pain to estrogen are shown in the diagram of 5 consecutive cycles in Chart 3. The pain began as rather typical *Mittelschmerz* but after 2 months it became practically constant. Exacerbations frequently occurred in mid cycle however when ovarian activity would be expected to be at a peak. This patient married in 1946. A year later she had a normal pregnancy resulting in a full term child. Pain continued irregularly through the early months of pregnancy but ceased after about the fifth month.

Administration of estrogen was followed by relief of pain in 3 out of every 4 cases in this group. It was tried in 53. No effect was observed in 14. In 39 there was relief and 23 of these were classed as remissions since symptoms were definitely improved for more than a week. The reaction to estrogen could usually be determined by injection of 10 to 16 milligrams of estradiol benzoate (see Chart 2). In 2 cases pain became cyclic following treatment with estrogen.

Anyone who has tried to evaluate the effect of a therapeutic agent administered for the relief of subjective symptoms realizes the difficulty of convincing himself that any improvement is not the result of suggestion. The menstrual aberrations however improved

along with the pain, and injection of other substances was without similar effect. The degree of relief appeared to vary with the dosage. The benefit from 16 milligrams of progynon B was often obviously greater than from 33 milligram. Pain was increased by chorionic gonadotropin and that of pregnant mare's serum.

In the most severe cases where the pain was constant and incapacitating just as in an attack of *Mittelschmerz*, estrogen was ineffective. Indeed when most needed it did not help. These cases present a very difficult problem. Ovarian specimens were taken for biopsy and the albuginea was cut in 2 cases with only temporary relief. Four cases in group 2 were treated with bilateral section of the ovarian plexus and vessels as described by Bigelow. There was temporary relief in 3, but the longest remission was only a month. In one case the pain became cyclic and it has remained so for more than a year. Two of the patients who experienced temporary relief from section of the ovarian plexus were further treated with presacral and bilateral lumbar sympathectomy (removal of the first to the fourth sympathetic ganglia on both sides). Both patients developed pain again after several

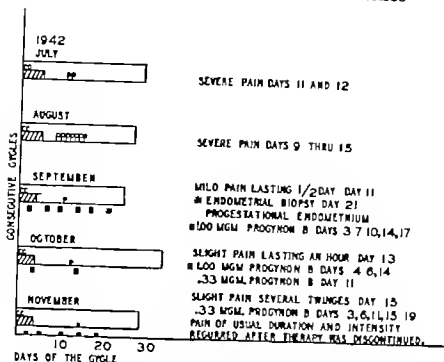


Chart 5. Case of P.S.

months of relief. In one it was on the opposite side. The pain has been less severe in both patients, however, and one has become pregnant.

The similarity of the symptoms and signs of this condition to those of chronic inflammatory disease is great. In some patients with long hospital records the diagnosis of salpingitis had been made but it was found to be unproved at the time and subsequent findings made it untenable. In most of the patients with repeated hospital admissions diagnosis of abdominal pain cause undetermined, had been made. Endometriosis also has features in common with this condition, and it was considered particularly in those patients in whom the pain was aggravated by the menses. Unlike endometriosis pelvic findings are normal in these cases even after many years of symptoms. There does not appear to be any unusual infertility.

It will be noted that pain in the right ovary is much more frequent than in the left. This suggests that the right ovary is the more active. This may be true. That the two ovaries are not equally functional has been noted (2). In 64 cases of cesarean section in which he could find it Williams noted the corpus luteum in the right ovary 36 times and in the left

28 (29). Presumptive evidence of the side on which ovulation occurred may be gained from the location of tubal and ovarian pregnancy. Ward Ekas found in a review of the cases of ectopic pregnancy at the Strong Memorial Hospital that in 180 cases it occurred 104 times on the right side and 76 on the left. According to Hartman ovulation occurs more frequently on the right side in the monkey.

Group 3. Cyclic intermenstrual pain or Mittelschmerz. The similarity of the pain so far described with *Mittelschmerz* is apparent. In 5 of the 15 cases in group 1 the pain which followed removal of one ovary was cyclic, and it is of interest that in the first case described by Wharton and Henriksen in their paper on periodic intermenstrual pain, typical *Mittelschmerz* made its appearance after the removal of one ovary.

Eleven of 25 unselected cases of *Mittelschmerz* had signs of ovarian dysfunction. There was intercytic bleeding in 8, menorrhagia in 2 and hot flashes in 2. The occurrence of intercytic bleeding with *Mittelschmerz* has been noted (22). In 8 cases treatment with estrogen was followed by relief of pain. Ovulation at times was prevented by large doses. In fact the original intention was

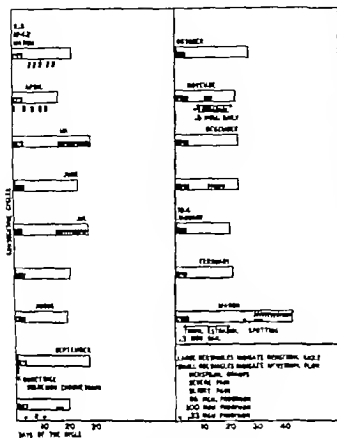


Chart 6 Case of R.B.

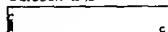
to give the patient relief from severe and prolonged pain by prevention of ovulation. But with smaller amounts pain in some cycles was reduced to insignificance, suggesting that ovulation was not prevented and in other cycles where there was no pain at all endometrial biopsy indicated that ovulation had occurred. Two cases treated with estrogen are described.

FS This woman tripara, began to have *Mittelschmers* in 1937 when she was 32 years old. The pain occurred on either side 9 to 17 days after the onset of the menstrual period and usually lasted 3 or 3 days. *Mittelschmers* began 3 years after the birth of her last child. Pelvic findings were normal.

Periods of observation and treatment in 1940-1941 and 1942 are illustrated in Charts 3 to 5. The importance of the amount of hormone given and the timing of the administration is shown. In April 1940 doses of estrogen progynon B sufficient to suppress or postpone ovulation were begun too late in the cycle to have any effect. A slightly smaller amount of the same hormone begun earlier and given more frequently the following July resulted in lengthening the menstrual interval to 45 days, indicating suppression or postponement of ovulation.

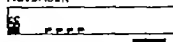
In January 1941 she was confined to bed with the most severe pain of her experience. The next month

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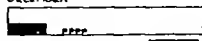


SEVERE, INTERMITTANT CYCLE
OVARIAN PAIN AND HYPO
MENORRHEA FOR THREE YEARS
STERILITY FOR EIGHT YEARS

NOVEMBER

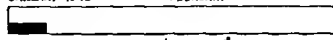


DECEMBER



JANUARY 1944

FEBRUARY



0 10 30 50
DAYS OF CYCLE

KEY

- C - MENSTRUAL CRAMPS
- P - SEVERE MITTELSCHMERZ
- E - ETHINYL ESTRADIOL 0.6 MG DAILY
- Q1 MG
- PRANONE 10 MG DAILY
- † - ENDOMETRIAL BIOPSY
- SECRETORY ENDOMETRIUM
- + - TEST FOR PREGNANCY POSITIVE

Chart 7 Case of H.R. aged 29. Spontaneous abortion occurred on June 24.

there was no pain probably indicating an anovulatory cycle rare for this individual. Pain recurred the next month. In May stillbesterol by mouth 1 milligram daily was begun after the *Mittelschmers* and continued through the 16th day of the next cycle. Typical pain occurred 10 days later on the 24th and 25th, 16 days before the onset of the following menses. The following month pain occurred on the 19th and 20th days, again 16 days before the onset of the next menses. Previously recorded *Mittelschmers* had not been later than the 17th day. Ovulation seemed to have been postponed in June by the administration of estrogen.

In August, 1942 the patient again sought relief of her *Mittelschmers* attempts at which had been futile until now because of the unusual persistence that month of the pain which lasted an entire week. Progynon B was again tried in a slightly smaller amount than previously injections of 10 milligram rather than 165 milligrams begun on the third day of the cycle in September and repeated on the 7th and 10th days. Only slight pain lasting about an hour occurred on the 11th day. Since it was not certain that the pain represented *Mittelschmers* estrogen was given again on the 14th and 17th days. That the pain was *Mittelschmers*, modified by the therapy was indicated by the occurrence of menstruation 14 days later and more important by the presence of a normal progestational endometrium revealed by endo-

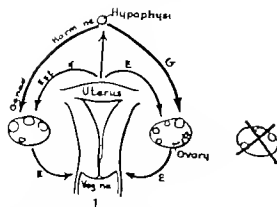
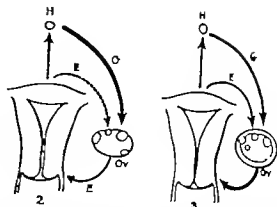


Fig. 1. Normal balance. The proper proportion of estrogen and gonadotrophic hormone is necessary for ovulation. By its effect on the hypophysis estrogen is keeping the production of gonadotrophic hormone in check. The uterus removes from the circulation an amount of estrogen determined by its size.

Fig. 2. Loss of one ovary. Because of the decrease of



estrogen, there is increased production of gonadotrophic hormone.

Fig. 3. Remaining ovary enlarges, restoring the balance. In response to the increased gonadotrophic stimulus, more follicles become active. If there is enough ovaries time remaining, the estrogen output increases sufficiently to restore the balance and normal function ensues.

metrial biopsy on the 21st day. Similar results were obtained during the next 2 months by the administration of relatively small doses of estrogen. In December 1942 when no therapy was given pain of the usual intensity promptly recurred and it continued regularly at least until 1945. There were however no attacks as prolonged as that in 1942.

R.B. In January 1941 at the age of 26 this nulliparous, married woman began to have crampy midpelvic pain tending to the right side, occurring in the middle of the interval and usually lasting until the menstrual flow began. Meneses had been fairly regular around 4 weeks since the onset at the age of 22 and lasted 5 days. She often had menstrual cramps the first day of the flow.

Pelvic examination revealed two small fibroids estimated at 2 centimeters in diameter. Otherwise examination was negative.

In March, 1942 estrogen therapy was begun as indicated in Chart 6. The original intention was to prevent ovulation, and this seems to have been accomplished at first, March-April 1942 when 1.66 milligram doses of progynon B were given. Later smaller doses were given with equally good results, and it became apparent that the beneficial effect was not dependent on the suppression of ovulation when endometrial biopsy on the first day of the flow following a painless interval, August, revealed secretory endometrium. The occurrence of menstrual cramps after the relief of the *Mittelschmerz* is also significant for although cramps on the first day of the flow are not a constant occurrence they would not be expected to occur in the absence of ovulation (21).

It will be noted that where injections were begun before the 5th day pain was obliterated or relieved, and this was accomplished with as little as .33 milli-

All of the diagrams represent the same phase of the cycle that of follicular growth preceding ovulation. Only one gonadotrophic factor the follicle stimulating, is considered.

gram of progynon B twice weekly (October). The postponement of ovulation by too large a dose of estrogen is illustrated by the last cycle on the chart, February-March, 1943. Ethinyl estradiol (Estroval) 3 milligram daily from the 4th through the 20th was followed 9 days later by the pain accompanied by estrogen withdrawal bleeding, and the cycle lasted 43 days.

A third case H.R. is illustrated in Chart 7. Here there was no *Mittelschmerz* following treatment with estrogen and ovulation was proved by the occurrence of pregnancy. The relief of dysmenorrhea and the sudden change in the fertility of this patient also indicate improved ovarian function.

ETIOLOGY OF OVARIAN PAIN

It would be specious to represent the two types of pain, cyclic and irregular as essentially different. They are probably different manifestations of the same process. That other signs of ovarian dysfunction are seen more frequently with irregular pain than with *Mittelschmerz* suggests that the former is a manifestation of a more serious dyscrasia. The occurrence of *Mittelschmerz* early in the history of some of the cases of irregular pain and its appearance after therapy in others, as well as the exacerbations of pain in midcycle, indicate a close relationship between the two types.

The nature of the underlying disorder is obscure. Ovarian tissue removed from the

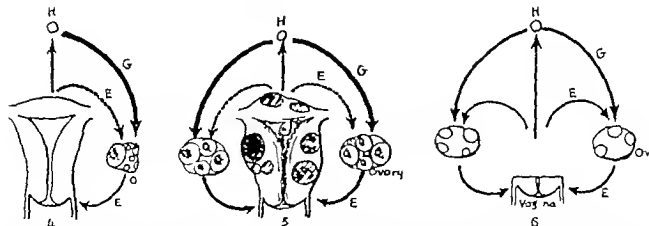


Fig. 4. Extreme partial castration. With the loss of much more than half of the original ovarian tissue, that remaining is inadequate and cannot produce the needed estrogen. The imbalance persists, and because of insufficient estrogen there is failure of ovulation. Persistent follicles and cystic changes result.

Fig. 5. With tumors of the uterus, the use of estrogen may increase to the point where an effect similar to that

resulting from loss of too much ovarian tissue is produced. The ovaries enlarge to capacity and then fall because of insufficient estrogen.

Fig. 6. Hysterectomy spares estrogen. It may relieve the condition which is illustrated in Figure 5 for a temporary period of time, but function ceases after a while because the uterus keeps the cycle going by its periodic use of estrogen.

cases in group 1, and the biopsies from 3 cases in group 2 revealed little which at present can elucidate the problem. In 2 of the biopsies a superficial overgrowth of fibrous tissue was noted possibly supporting the idea readily arrived at intuitively that pain is caused by too resistant ovarian fibrous tissue (tunica albuginea). If the albuginea were too dense there would be abnormal pressure as follicles increased in size and if the follicular growth were thus impeded production of ovarian hormones would be reduced. Both the pain and the dysfunction might be explained in this way. The condition described by Goodall as chronic cystic ovarian sclerosis may in varying degrees account for this syndrome. Estrogen may produce its beneficial effect by improving the blood supply of the ovary.

THEORETICAL CONSIDERATIONS

The occurrence of pain in the remaining ovary after the removal of one ovary along with the appearance or aggravation of other signs of ovarian insufficiency the beneficial effect of estrogen and the ovarian failure resulting from extreme partial castration exemplified by case H C have inspired the hypotheses illustrated in Figures 1 through 7.

The uterus should be considered in any theory of ovarian function for its removal is followed first by an apparent increase and

later by an early decline of ovarian activity. The increase is indicated by the prolongation of the life of the corpus luteum by hysterectomy (12). This is explained by the estrogen sparing effect of that operation. The supply of estrogen is greater following excision of the uterus which when present removes estrogen from the circulation (8). Hysterectomy not only spares estrogen however, but it results in the early cessation of the ovarian cycle (16, 17, 18, 4). It seems that in order to function the ovary must be stimulated intermittently. Decline of ovarian activity earlier than normal after hysterectomy may be explained if one assumes that the use of estrogen by the uterus is cyclic, and that wide fluctuations of estrogen and gonadotrophic hormones observed in normal women (23) are necessary for normal ovarian function. Removal of the uterus results in decreased fluctuations in the level of estrogen and is therefore followed by earlier ovarian failure. By the periodic growth of the endometrium the level of circulating estrogen is made to fluctuate. The periodic changes in estrogen concentration cause fluctuations in the hypophyseal gonadotrophic hormone which in turn stimulates the ovary intermittently. Thus the uterus takes an active part in the functional balance of ovary and pituitary. One may think of the uterus as the balancer on a seesaw having the

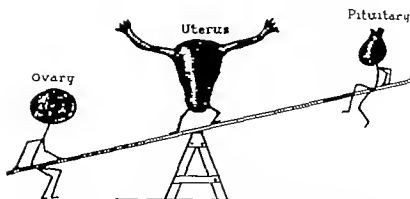


Fig. 7. Normal function may be thought of as maximum activity of a seesaw. If any of the members gets out of balance inadequate activity results and normal function ceases. Large periodic fluctuations in the amounts of estrogen and gonadotrophic hormone are necessary for normal function, and the uterus enhances the fluctuations by its periodic use of estrogen.

ovary on one end and the pituitary on the other. When the uterus is absent motion of the seesaw representing function becomes feeble and then stops, just as it does if either of the riders on the seesaw stops working (Fig. 7).

Normal function may be thought of as violent or maximum action of the seesaw; various degrees of abnormal function as grades of inadequate activity. Observed relief of functional gynecological disorders with practically any procedure and therapeutic agent can be rationalized if one thinks of them as improving the action of the seesaw. Measures which have been reported to be beneficial include curettage, x-ray to ovaries and hypophysis, injections of gonadotrophics and male as well as female hormones. Anything which sufficiently stimulates or suppresses the hypophysis or the ovary directly or through the nervous system or has an effect on the estrogen utilizing capacity of the uterus may improve the action of the seesaw. Large amounts of estrogen may stop feeble activity altogether by suppression of the hypophysis and make possible a rebound of maximum activity after release of the inhibition. The beneficial effect of 5 milligrams of stilbesterol daily for 20 days in ovarian dysfunction observed by Karnaky and Patton may be explained in this way. The relief of the sterility as well as the *Mistelschmerz* and dysmenorrhea of H. R. in group 3 may thus have resulted from the improved ovarian function produced by a large amount of estrogen.

According to this theory an amount of estrogen sufficient to affect the hypophysis but not enough to suppress it altogether might be expected to dampen the ovarian cycle and result in abnormality. It would neither stop the pituitary-ovarian seesaw allowing for a later rebound, nor would it boost its activity. Ovarian dysfunction would result. This is illustrated by a case described by D'Amour and Woods in which dysfunctional bleeding occurred in a normal woman following daily administration for 2 months of 0.4 milligram of estradiol by injection.

The experiments of Westman, mentioned earlier, indicate that estrogen is necessary apart from any effect on the pituitary for normal ovarian function. It is perhaps pertinent that synergism of estrogen with gonadotrophins in effects of the latter on the ovaries of hypophysectomized rats has been observed (30, 15, 19). Both gonadotropin and estrogen are needed for ovulation and the formation and survival of the corpus luteum. Figures 1 through 4 illustrate a theoretical synthesis of this with the work of Lipschultz showing that on the removal of ovarian tissue relatively more follicles in the remaining tissue are stimulated to activity and function remains normal up to a certain point, but after too much has been removed function ceases and the ovarian remnant becomes cystic. The mechanism of the ovarian failure of extreme partial castration illustrated in Figure 4 may be the same as that associated with lesions of

the uterus which result in increased removal of estrogen from the circulation (Fig. 5 through 7). The association of menstrual irregularities and cystic ovarian changes with uterine fibroids has long been recognized. It has been suggested that the cysts may be the cause of the tumors by the production of excess estrogen (31,32), but it is possible that the uterine tumors disturb the ovarian function by lowering the estrogen to a point where an effect is produced comparable to that caused by the loss of too much ovarian tissue (see Figs. 4 and 5). In the case of growing tumors of the uterus one would expect a gradual increase in the activity of the ovaries until the limit of their ability to produce more estrogen is reached following which the signs of failure would begin. The nature of the tumors some containing more muscle tissue than others and their location some encroaching on and causing an increase in the amount of endometrium would determine their thirst for estrogen and explain the variation in the effects of these tumors in different individuals.

A case which is described by Wharton and Henriksen in their paper discussing periodic intermenstrual pain supports this hypothesis. Intermenstrual pain without ovulation, a sign of ovarian failure, ceased after removal of a myomatous uterus. Description of the case is quoted.

A Jewess aged 30 began to menstruate at the age of 13, the menses had always been regular every 28 days lasting from 6 to 7 days with profuse flow. She had conceived normally in 1930. Intermenstrual pain accompanied by spotting began in 1933. She was operated on at the Sinal Hospital in July 1935, because of uterine myomas with profuse menstrual hemorrhage. We performed the hysterectomy deliberately on the second day of the intermenstrual pain and spotting 9 days after the close of the last menses, expecting to find signs of ovulation. The ovaries however showed no evidence whatever of graafian follicles or corpora lutea. In short, there was no sign of ovulation, although the menstrual cycle had been normal and the patient had the menses that accompany ovulation. Since July 1935 she has been completely relieved of the intermenstrual pain and spotting. The pathologic diagnosis in this case was uterine myomas, endometrial hyperplasia with polyp, and endometrial glands invading the uterine wall.

In one case in group 2 the uterus was removed because of prolonged bleeding which

did not respond to conservative measures. The pain ceased after hysterectomy although the ovaries remained untouched.

The above considerations have dealt with ovarian insufficiency. Hyperfunction of the ovaries is also possible. The syndrome described by Stein characterized by hirsutism and amenorrhea may be caused by hyperfunction of the ovaries for it is relieved by the removal of ovarian tissue. The wedge operation by which it is successfully treated can have little permanent effect beyond the reduction of the ovarian mass.

SUMMARY AND CONCLUSIONS

Ovarian pain can occur in the absence of any demonstrable lesion of the ovary and it may have no regular relation to the menstrual cycle. Its frequent association with menstrual irregularities indicates that the pain is itself a sign of ovarian dysfunction.

This syndrome of ovarian pain, menstrual aberrations and other signs of ovarian failure such as hot flashes occurs in all ages of reproductive life.

The more frequent occurrence of pain on the right side in these cases in addition to other evidence suggests that the right ovary in women is the more active.

By the presentation of cases in which ovarian tissue has been removed in women and the citing of the known effects of partial castration in animals the importance of an adequate mass of ovarian tissue for normal function is shown and the need for conserving ovarian tissue in women is stressed. If one ovary is removed because of this type of pain signs of ovarian insufficiency and pain in the remaining ovary may be expected.

The beneficial effect of therapy with estrogen including alleviation of cyclic intermenstrual pain without the prevention of ovulation suggests that the importance of the mass of ovarian tissue lies in its production of estrogen.

A theory of ovarian function is presented which includes the rôle of the uterus.

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ENDOMETRIOSIS AS A CAUSE OF INTESTINAL OBSTRUCTION

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ALTHOUGH endometriosis¹ with involvement of the small and large intestine is encountered only occasionally it occurs with sufficient frequency to justify giving it a position among the important benign lesions of the bowel. It further commands our interest because it represents a benign condition which at times exhibits such infiltrative tendencies as to make its lesions rather easily confused with malignant neoplastic processes. Especially is this true in those occasional circumstances in which extensive invasion of the intestinal wall by the lesions of endometriosis so compresses the lumen of the invaded segment that complete or incomplete intestinal obstruction ensues. The present report deals with a number of such cases seen and studied from the surgical files of the Mayo Clinic. We feel that throughout the literature the importance of this complication has not been sufficiently stressed.

HISTORICAL REVIEW OF CASES

In 1909 Meyer gave a detailed report of a 45 year old woman who required operative intervention for the relief of a lesion which we should now term obstructing endometriosis of the bowel. In 1918 Lockyer referred to this case in his textbook *Fibroids and Allied Tumors*. In 1920 Cullen reported a case of sigmoidal obstruction on the same basis, which has since become more or less classic among writers of modern textbooks of gynecology.

Sampson in 1921 in his definitive paper on endometriosis described a sigmoidal endo-

metrioma and cleared the field for subsequent recognition of these lesions as local proliferations of ectopic endometrial tissue. In 1923 Judd and Foulds recorded 5 instances of sigmoidal endometrioma, in 3 of which definite degrees of intestinal obstruction were manifest. In 2 of the 3 cases recorded in 1927 by Graves the rectal lumen was compromised. In his third case there was chronic intermittent obstruction of the sigmoid resulting from an infiltrative endometrioma.

A rectal carcinoma was coexistent with a low sigmoidal endometrioma in the case recorded in 1932 by Brane. Endometriosis of the sigmoid portion of the colon produced local obstruction in the case reported in 1935 by Bartlett. In Marmol's case in 1935 a 24 year old woman exhibited signs and symptoms of rectal obstruction resulting from the continual growth of an endometrioma of the rectovaginal septum.

In 1937 Cattell made an important contribution in his report of 17 cases demonstrating involvement of the lower portion of the bowel. Two of 4 patients with sigmoidal endometriosis had almost complete intestinal obstruction. Eight patients exhibited lesions fairly high in the rectum including its junction with the sigmoid and all had experienced some degree of "clinical" obstruction. Definite obstruction was manifest in 2 of the remaining 5 instances in which the rectovaginal septum was the seat of involvement.

In 1940 Glenn and Thornton published their observations on 2 patients who had obstructing endometriomas of the ileum. In a review of the literature they were able to find only 4 additional cases in which there was any degree of obstruction on a similar basis.

Two recent cases of intestinal obstruction caused by endometriosis reported by Thierstein and Allen along with individual reports of a similar nature by Mouat, Lee, Starr

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²Abridgment of part of a thesis submitted by Dr. McGuff to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M.S. in Surgery.

³Correct usage dictates that the term "endometriosis" be used to indicate the condition which exists when endometrial tissue is found in any extruterine location. When the lesions are tumefactive the designation "endometrioma" is often employed.

Schuler Gale, Goodwin Behrendt and Neumeyer Okinczyk, Friedman Hepburn, Papin, Josefsson Grigsby Patton and Patton Milnor Blaikley Morrin, Lukins and Lukins, Ben-Asher and Wood Deibert, and Kain comprise the literature on this interesting condition (13 18 20 27 29) the frequency and the importance of which have not received a merited degree of attention in medical writings of the past 25 years.

MATERIALS AND METHODS

Over the period from 1920 to 1946 inclusive, the surgical files of the Mayo Clinic were found to contain records of 48 cases in which the diagnosis of endometriosis of the bowel had been made by a pathologist. In 16 of these 48 cases pathologic material had been removed in an effort to alleviate clinical symptoms and signs of intestinal obstruction caused by cicatrizing endometriosis. The present study concerns these 16 cases.

Material preserved from all of these lesions was secured and studied in gross detail with special reference to such features as the degree of local narrowing of the intestinal lumen the presence or absence of mucosal ulceration the degree of spread above and below the point of major impingement as measured by gross in duration of tissues, the thickness of the intestinal wall and the amount of reactive fibrosis. In those instances in which wide resection had been performed an estimate was made of the degree and duration of the obstruction by comparing luminal diameters of the bowel above and below the level of the lesion and correlating these with the thickness of the uninvolved proximal and distal segments relative to the muscularis propria. Numerous small representative blocks were cut from different levels and these were placed in bottles containing a fresh 10 per cent neutral solution of commercial formalin. Microscopic sections were then prepared using the paraffin method. Routine hematoxylin and eosin stains were employed in this study but in addition the van Gieson method was used for demonstration of fibrous tissue and a stain using the Prussian blue reaction was utilized in order to bring out the presence of hemosiderin.

CLINICAL ANALYSIS

The average age of the 16 patients who had intestinal obstruction caused by endometriosis was 39.5 years with extremes of 31 and 54 years. Seven patients were in the fourth, 8 in the fifth and 1 in the sixth decade of life. There were no colored patients in this series of cases.

Ten of the women had been married for periods of from 4 years to 25 years with an average of 11.1 years. Four were single. Two were separated from their husbands.

Symptoms All of the patients had complained of one or more symptoms for periods ranging from 2 months to 18 years with an average of 6.5 years. As will be shown in subsequent paragraphs many of these symptoms are related to the early stages in the development of the endometriosis. Those relative to the effects of intestinal invasion will be discussed first, as being most pertinent to the problem under investigation.

Four of the patients (all with sigmoidal lesions) were suffering from complete stoppage of the bowels at the time of initial examination. In this group the picture was typical of acute obstruction with lower abdominal pain abdominal distention and complete obstipation with no passage of feces or flatus. In an additional 6 cases the symptoms pointed to the existence of partial intestinal obstruction of rather severe degree but which allowed the passage of some gas through the point of narrowing. In 3 of these cases the sigmoid portion of the colon in 2 the rectosigmoidal junction and in 1 the distal portion of the ileum were respectively the sites of pathologic narrowing by the process. In the remaining 6 cases progressively severe constipation, constipation alternating with diarrhea, abdominal distention and other symptoms listed subsequently became progressively worse in an intermittent fashion and indicated the progression of gradual narrowing of the bowel. These we classified as cases of chronic obstruction. In 3 of these cases the sigmoid portion of the colon was the seat of the obstruction with the rectosigmoidal segment accounting for another and the distal portion of the ileum as the site of the remaining two lesions.

Considering the group as a whole moreover we find additionally that all 16 of the patients complained of cramping abdominal pain. Abdominal distention and severe constipation were prominent in all 10 cases falling into the first two groups listed in the preceding paragraph. Vomiting had occurred as a symptom in 1 of the 3 cases of obstructing endometriosis of the ileum and in 4 of the remainder.

Symptoms which might be attributed in part to the process in its preobstructive stage might be listed as intermittent constipation noted by 13 patients as being worse at the time of menstruation than at other times. Five of the patients had suffered from intermittent attacks of diarrhea and 4 of these had had alternating periods of constipation and diarrhea. Grossly bloody stools had been noticed by 3 patients. This symptom had been present only with menstruation. Four of the patients had sustained loss of weight in one case to the extent of 27 pounds (12.2 kg). It was felt that in these cases abdominal distress resulting from incipient obstruction had led to decreased dietary intake. An earlier group of symptoms are related more to the existence of pelvic endometriosis than to its intestinal complications and are herein mentioned to complete the picture on a chronic basis.

Infertility relative or absolute was frequently present and 9 of the patients complained of absolute sterility. The 10 married women in the series had had a total of but 3 pregnancies only 2 of which terminated with the birth of live children. One of the 4 unmarried patients had had a pregnancy which terminated in (or was terminated by) abortion. Among the 4 women who had been pregnant the average period which had elapsed since the last pregnancy was 14.2 years with extremes of 5 and 23 years. The importance of these findings is further emphasized by the fact that 6 of the 10 married patients mentioned had undergone previous pelvic operations designed in several instances to make pregnancy possible by resecting regions of endometriosis.

Acquired dysmenorrhea was a major symptom in 8 of the 16 cases. In an additional 4 cases the patients did not complain of this symptom. In the remaining 4 cases the rec-

ords did not supply information on this point. Dyspareunia, surprisingly enough was not listed as a major symptom by any patient in this group. It was elicited as not being a symptom in 2 cases and in the remainder the records were noninformative. However 5 of the 13 patients whose lesions were found in the lower segments of the bowel had complained of rectal pain and several others had complained of pain on defecation. Menstrual irregularities, so prominent in cases of pelvic endometriosis were noted in only 4 of the cases. In 9 the periods were described as being regular 2 patients had undergone previous hysterectomy and 1 patient had been amenorrheic for 3 years as a consequence of the menopause. Menorrhagia was noted as a symptom 4 times among the group and 2 patients having otherwise normal menses had complained of some intermenstrual spotting.

The aforementioned symptoms which were relevant to the underlying endometriosis rather than to its obstructive complication had been present for periods varying from several months to 18 years with an average duration of 6.5 years.

Physical findings in all 16 cases were consistent with the clinical diagnosis of intestinal obstruction. On the basis of an evaluation of symptoms combined with the results of digital rectal and vaginal examination the correct diagnosis was made preoperatively in 7 of the 16 cases studied.

Sigmoidoscopic examination was performed in 12 cases and in 9 of these positive evidence of luminal narrowing was obtained. In 2 cases as was proved later the sigmoidal lesions were beyond the reach of the sigmoidoscope and in the third case in which the findings were negative the lesion was located in the terminal portion of the ileum. In none of the cases was the presence of mucosal ulceration observed. In several cases however the sigmoidoscopist remarked on the peculiar puckering of the mucosa over the area of involvement.

In 9 of 11 cases results of roentgenographic study after administration of barium enemas were interpreted as being positive inasmuch as the roentgenograms demonstrated and localized the point of the obstruction. The

two failures were in a case in which the lesion was ileal and in another in which the upper portion of the rectum was only mildly obstructed by the endometrioma. By way of offsetting these 2 cases the roentgenologist in 2 of the less 'positive' examinations suggested the diagnosis of obstructing endometrioma.

TREATMENT¹

Fifteen of the 16 lesions were treated surgically by local resection of the bowel and in 1 instance partial excision of the endometrioma was accomplished. The details of the various procedures in the 16 cases follow

a When the point of obstruction was in the sigmoid or distal to it Resection of the bowel was done in 12 of the 13 cases in this group and in 1 the endometrioma was excised. In 5 of the cases complete resection of a segment of the bowel was done and in 1 case the resection of the bowel was partial. In this group of 12 resections of the bowel colostomy was performed 8 times and cecostomy was performed once. In 2 patients in their early thirties in this group myomectomy was performed plus resection of the bowel in a conservative effort to preserve reproductive function. Resection of the lower part of the bowel plus removal of both tubes and ovaries or of the remaining tube and ovary was done in 5 cases. Panhysterectomy plus resection of the bowel was done in 1 case and panhysterectomy plus partial excision of the endometrioma was done in 1 case.

b When the point of obstruction was in the distal portion of the ileum Enterostomy plus ileal resection was done in 1 case. An initial Witzel ileostomy and a subsequent right hemicolectomy and ileotransversostomy were done in 1 case. Ileal resection plus ileocecostomy and removal of the remaining tube and ovary were done in 1 case.

These patients had been followed up by examination and letters for from 1 month to 21 years. An excellent result with complete relief of the symptoms was obtained in 12

cases, a good result in 2 cases, and a fair result in 2 cases.

There were no deaths.

REPORT OF CASES

CASE 1 A single, white woman 43 years of age complained of symptoms fairly typical of partial obstruction of the small intestine of 3 months' duration. Physical examination revealed an emaciated weak woman who had abdominal distention and visible peristaltic waves. A roentgenogram of the colon was positive for obstruction of the small bowel. Medical treatment in the form of a double blood tube blood transfusions and supportive therapy was instituted. Complete obstruction occurred 1 week after admission. A Witzel type enterostomy was done and it was believed that ileocecal obstruction caused by a carcinoid existed. Four weeks later right colectomy was carried out with side-to-side ileocolostomy. No abnormality of endometrium was found in the pelvis. Pathologic examination revealed that the obstruction was caused by a deposit of endometrial tissue in the terminal portion of the ileum (Fig. 1).

CASE 2 A white woman 33 years of age who had been married for 9 years but had never been pregnant, complained of episodes of colicky lower abdominal pain of several months' duration. She had always been constipated. She suffered from severe acquired dysmenorrhea. Abdominopelvic examination showed tenderness and some rigidity in the right lower quadrant of the abdomen and an irregular, tender mass in the right adnexa. On abdominal exploration 3 small contracted and scarred regions were found in the terminal portion of the ileum. The middle region was producing partial obstruction of the terminal portion of the ileum. About 6 inches (15 cm.) of the ileum, including the three regions, was resected and an end-to-end anastomosis was made. The pathologist reported the process as one of multiple endometrioma of the ileum with partial intestinal obstruction. The patient made an uneventful recovery.

CASE 3 A white woman 32 years of age married for 10 years but never pregnant, complained of symptoms fairly typical of partial colonic obstruction which were present for 10 days prior to each menstrual period. She stated that 3 years previously myomectomy and left oophorectomy had been performed. Nine months prior to admission the symptoms of obstruction had begun to increase in severity. For 2 months obstruction had been almost complete.

Physical examination revealed a thin, malnourished woman. Pelvic examination indicated the presence of a large mass probably an ovarian cyst, in the right adnexa. Proctoscopic examination indicated this mass and the angulation of the bowel produced by it. Abdominal exploration was carried out for carcinoma of the sigmoid with obstruction. Because of the huge dilatation of the colon and

¹It is to be emphasized that most of the cases in the current series occurred before the time of the changing concept of treatment from that of resection of the bowel to that of bilateral oophorectomy. Present treatment consists in panhysterectomy plus conservative treatment of the bowel.

cecum proximal to the mass in the sigmoid and a large simple cyst of the right ovary oophorectomy and right salpingo-oophorectomy were done. Three weeks later resection of 20 centimeters of sigmoid which contained the mass together with a portion of the posterior uterine wall was carried out and an end-to-end anastomosis was made. The patient made a good recovery. Pathologic examination showed complete sigmoidal obstruction by the endometrioma.

CASE 4. A white single woman 31 years of age who had had 1 pregnancy which had ended in abortion complained of intermittent pain in the right lower quadrant of the abdomen of 9 years duration which occurred 1 week before during and after menses. The pain had been progressively increasing in severity and for the past month had been persistent without relief. Previous surgical treatment included appendectomy done 9 years before and left radical and right simple mastectomy done 3 years before for bilateral intraductal papillary carcinoma.

Abdominal examination revealed in the region of the cecum a peculiar ovoid flat tumor which was movable and tender. On exploration of the abdomen a region of endometriosis was found to be partially obstructing the terminal portion of the ileum. Right salpingo-oophorectomy and resection of the terminal portion of the ileum with ileocectomy and an end-to-side anastomosis were done. The patient made an uneventful recovery. The pathologist reported partial ileal obstruction by a region of infiltrating endometriosis.

CASE 5. A white married woman 54 years of age who had been pregnant once and was 3 years past the menopause complained of bleeding from the rectum and constipation—both of 18 months duration. Other symptoms of which she complained were excessive gas and occasional pain in the left lower abdominal quadrant which were relieved by repeated enemas. Rectal examination disclosed a carcinoma on the posterior rectal wall and biopsy showed this to be an adenocarcinoma, grade 1 (Broder's method). A roentgenogram of the colon revealed a partially obstructing lesion high in the sigmoid with occasional diverticula below this point. The carcinoma of the rectum was treated with radium and the patient returned in 3 months for an abdominal exploration. Marked obstruction of the midsigmoid by a lesion that grossly resembled endometriosis was found. An area of the sigmoid including the lesion was removed by an exteriorization operation by the clamp method. One month later radical posterior resection was done for the removal of a recurring adenocarcinoma of the rectum. The patient's recovery was uneventful. Pathologic examination of the specimen showed an endometrioma of the sigmoid which had caused almost complete obstruction.

CASE 6. A white woman 45 years of age who had had 1 child and was now separated from her husband complained of severe lower abdominal cramping

pain on the first 2 days of her period a sense of pressure in the lower part of her abdomen and sacral backache—all of 5 months duration. One year previously vaginal myomectomy dilatation and curet tage and perineorrhaphy had been performed. Metrorrhagia had been present for 5 weeks.

Pelvic examination showed marked cervicitis and erosion and a suspicious "precancerous" region on the posterior lip of the cervix. On abdominal exploration a nodule in the sigmoid causing almost complete obstruction was found. A first stage Mikulicz operation and panhysterectomy plus appendectomy were performed. About 2 weeks later a second stage Mikulicz operation was done and the colonic stoma was closed 4 months later. Recovery was good. The pathologist reported sigmoidal obstruction caused by endometriosis.

CASE 7. A white single woman 46 years of age complained of dull pain across the lower part of the abdomen and severe constipation of 5 years duration. She stated that 5½ years previously subtotal hysterectomy and left salpingo-oophorectomy had been performed and 5 years previously colostomy had been performed to relieve an acute sigmoidal obstruction caused by what was believed to be a malignant lesion.

Sigmoidoscopic examination revealed marked narrowing of the lumen of the sigmoid. The mucosa was intact and the narrowing appeared to be due to an extrarectal mass. On exploration of the abdomen a structured region just above the rectosigmoidal juncture was found. This region was resected and an end-to-end anastomosis was made over a rubber tube. Six months later the colonic stoma was closed. Pathologic examination of the specimen showed sigmoidal obstruction caused by an endometrioma.

CASE 8. A white woman 43 years of age, who had been married for 17 years without ever having become pregnant, complained of symptoms fairly typical of chronic intermittent partial intestinal obstruction of 12 years duration. She stated that appendectomy had been done 21 years previously, partial hysterectomy and right salpingo-oophorectomy had been done 14 years previously and hemorrhoidectomy 3 years previously.

Pelvic examination showed no uterine fundus and a fairly normal cervix. The roentgenogram of the colon showed a constriction high in a redundant sigmoid which was questionably caused by some extrinsic process. On abdominal exploration endometriosis was found involving the mesentery of the midsigmoid and almost completely encircling the intestinal lumen causing marked constriction in this region. An exteriorization operation with removal of the lesion and left salpingo-oophorectomy was accomplished. The patient made an uneventful recovery. The pathologist reported sigmoidal obstruction caused by a region of endometriosis which had practically encircled the sigmoid had deeply infiltrated the intestinal wall and had reduced the diameter of the lumen to 5 millimeters.

CASE 9. A white woman 41 years of age, who had been married for 12 years without becoming pregnant, complained of "comenstrual" constipation of 5 years duration. Three weeks prior to admission she presented symptoms that were fairly characteristic of colonic obstruction. Physical examination revealed that the uterus was somewhat fixed in the midposition by a thickened mass in the region of the left broad ligament and by nodules in the pouch of Douglas which via the vaginal speculum appeared blue-domed. A roentgenogram of the colon showed a lesion in the sigmoid which had completely obstructed the retrograde flow of barium. On abdominal exploration the pelvic mass was found to involve the posterior wall of the uterus and the sigmoid. Transverse colectomy was performed. One month later the lesion and a part of the midportion of the sigmoid were resected and an end-to-end anastomosis was made. The colonic stoma was closed later and a series of roentgen treatments over the adnexa was given to produce cessation of ovarian function. The patient made a good recovery. Pathologic examination showed sigmoidal obstruction caused by diffuse endometriosis of the sigmoid.

CASE 10. A single white woman 41 years of age complained of severe "comenstrual" constipation of 18 years duration and of symptoms fairly typical of chronic intermittent partial intestinal obstruction for the last few years. She stated that appendectomy had been done 13 years previously and unilateral salpingo-oophorectomy 1 year previously.

Physical examination showed a slightly enlarged uterus with a pedunculated egg-sized fibroid on its wall. Sigmoidoscopic examination revealed sharp anterior angulation of the bowel at 20 centimeters. A roentgenogram of the colon showed a long constricting obstructing lesion in the midsigmoid. The abdomen was explored and extraperitoneal resection of an endometrioma of the lower sigmoid was done with a catheter colectomy which was later closed. The patient made an uneventful recovery. The pathologist reported sigmoidal obstruction by a discrete endometrioma.

CASE 11. A white married woman 48 years of age who had never been pregnant complained of severe constipation and acquired menstrual pain. During menstruation she was obtunded for 1 or 2 days. Ten years previously she had undergone partial hysterectomy because of tumors and menorrhagia.

Physical examination revealed a hard mass filling the pouch of Douglas. Abdominal exploration was performed and, low down between the vaginal vault and the rectum a hard mass suggesting an endometrioma and causing definite obstruction was found. A portion of the bowel was resected and an end-to-end anastomosis plus appendicostomy was done. The patient made an uneventful recovery. Pathologic examination of the specimen revealed obstruction by a large endometrioma.

CASE 12. A white woman 38 years of age who had been married for 10 years without having become

pregnant complained of severe "comenstrual" constipation. Rectal "soreness and aural pain. Physical examination revealed a slightly irregular mass in the posterior fornix between the rectum and the vagina measuring 4 by 4 centimeters and protruding into the rectum. Sigmoidoscopic examination showed an anterior extrarectal mass at about 15 centimeters above the anus. Abdominal exploration revealed an endometrioma on the anterior wall of the sigmoid with definite obstruction. The anterior wall of the sigmoid with the tumor was resected and the bowel was closed transversely. Myomectomy, appendectomy and excision of other regions of endometriosis were accomplished. The patient made a good recovery. The pathologic specimen consisted of the resected endometrioma covered on one aspect by a layer of colonic mucosa.

CASE 13. A white married woman 45 years of age, who had never been pregnant, complained of "comenstrual" constipation and pain in the left lower quadrant of the abdomen of 4 years duration. Six months previously she had had symptoms fairly typical of acute intestinal obstruction and on abdominal exploration an obstructive lesion thought to be nonmalignant had been found in the rectosigmoidal region. Colectomy had been performed.

Physical examination revealed abdominal distention. A roentgenogram of the colon showed an irregular filling defect in the sigmoid near the colonic stoma. Sigmoidoscopic examination showed obstruction of the bowel at 24 centimeters as if by external pressure. Abdominal exploration showed a pelvic mass involving one loop of small intestine and a portion of the sigmoid. The loop of small intestine was mobilized and the portion of sigmoid resected. An end-to-end anastomosis was made. The patient's recovery was satisfactory and the colonic stoma was closed 1 month later. The pathologist reported sigmoidal obstruction by an infiltrating region of endometriosis.

CASE 14. A white woman aged 31 years, who was separated from her husband and who had had 1 pregnancy 5 years previously which had been terminated by a self-induced abortion complained of 4 to 5 loose stools with slight bleeding per day for 3 days premenstrually accompanied by intermittent cramping abdominal pain and later postmenstrual constipation—all of 6 months duration. She stated that 1 year after the aforementioned self-induced abortion dilatation and curettage had been performed because of menorrhagia, clots, and severe pelvic pain.

Physical examination demonstrated bilateral cystic adnexal masses and a firm mass in the pouch of Douglas which encroached on the anterior intestinal wall. Sigmoidoscopic examination showed adhesion of the anterior sigmoidal wall to an extrarectal mass, angulation of the bowel to the left, and marked luminal obstruction—all consistent with endometriosis. A roentgenogram of the colon showed fixation of the lower part of the sigmoid and luminal narrowing by an extrinsic process consistent

with endometriosis. Abdominal exploration revealed that the endometriosis was almost completely kinking the sigmoid and had attached it to the back of the cervix. Panhysterectomy appendectomy and biopsy of the endometrioma of the sigmoid were performed. Recovery was uneventful. The pathologist reported endometriosis of the sigmoid extensive endometriosis of the posterior surface of the uterus and bilateral chocolate ovarian cysts.

CASE 15 A white married woman 32 years of age who had never been pregnant, had previously complained of severe menstrual constipation and rectal pain. She stated that 2 years previously the left tube and ovary had been removed because of pain in the left lower abdominal quadrant. Five months previously symptoms consistent with complete colonic obstruction had developed. On exploration of the abdomen what was thought to be a malignant lesion had been found to be obstructing the lower part of the sigmoid. Colostomy had been performed.

Physical examination on admission showed nodularity of the uterosacral ligaments and an extra rectal mass behind and to the left of the cervix. Sigmoidoscopic examination revealed an anterior extra rectal mass at 18 centimeters which impinged on the lumen of the bowel. On abdominal exploration an endometrioma of the sigmoid which had caused obstruction was found. The involved portion of the sigmoid was firmly adherent to the cervix. The uterus, right tube and ovary and the portion of the sigmoid including the lesion were removed. End-to-end anastomosis was performed and also appendectomy. The colonic stoma was closed 7 months later. The pathologist reported that in the resected portion of the sigmoid there was a region of endometriosis 4 by 3 by 2 centimeters infiltrating into the sigmoidal wall and causing obstruction.

CASE 16 A white married woman 35 years of age who had never been pregnant, complained of diarrhea, gas, and abdominal colicky pain which were present on the first few days of menstruation. Ten months previously the patient had had an acute episode of lower abdominal colicky pain with vomiting and no bowel movement for 3 days. Previous surgical treatment had consisted of appendectomy done elsewhere and curettage done as a sterility study measure 1 year before.

Physical examination revealed an extrarectal nodular mass about 2 centimeters in diameter on the anterior rectal wall. Sigmoidoscopic examination showed at about 12 centimeters up on the anterior rectal wall an impinging region of induration about the size of a 5 cent piece and a roentgenogram of the colon showed a deformity of the sigmoid. Exploration of the abdomen showed that an endometrioma measuring about 1 1/4 inches (4 cm.) in diameter and situated at the bottom of the pouch of Douglas was causing almost complete obstruction of the sigmoid. A segment of the sigmoid containing the endometrioma was resected and an end-to-side anastomosis was established. The patient made an

uneventful recovery. Pathologic examination of the specimen showed the sigmoid doubled on itself with a large endometrioma in its midportion (Fig. 2). The obstruction had been caused by infiltration of the mass into the sigmoidal wall and compression of the sigmoid by the mass.

PATHOLOGIC OBSERVATIONS

Pertinent gross pathologic observations noted on the 15 resected lesions and the 1 partially excised lesion were as follows:

Nature Three sigmoidal lesions had produced obstruction by virtue of an annular or napkin ring type of infiltration with more or less concentric narrowing of the intestinal lumen. In 8 additional cases (2 lesions classified as high rectal and 6 as sigmoidal) the appearance was that of polypoid submucosal infiltration producing obturation of the intestinal lumen. In 2 other instances an eccentric cicatrization produced by infiltrating endometriomas had produced acute angulation while at the same time submucosal proliferation of the endometrial tissue gave a superadded factor of obturation. A combination of impingement and kinking from endometrial adhesions obtained in the 3 cases of ileal endometrioma with obstruction.

Size Gross limits of the infiltrations varied from 6 by 4 by 2 1/2 centimeters to 1 by 1 by 1 centimeters. The average dimensions were 2 1/2 centimeters in diameter with 7 of the endometriomas exceeding this size.

Color The dark red mottled appearance so characteristic of the lesions as seen at operation was replaced in the formalized specimens by the presence on the peritoneal and cut surfaces of scattered bluish spots on a whitish brown background of fibromuscular tissue. Some of the cut surfaces presented a striated appearance and from them tiny drops of brownish black fluid could be expressed by scraping with a knife.

Consistency mucosal serosal relations and so forth The involved tissues were nodular firm and fibrous without sharp delineation in the zones demarcating the edges of the infiltrations. In 9 instances the overlying mucosa was puckered in a roset fashion. In 6 it was irregularly pitted and in 1 case it presented an edematous polypoid appearance. Although no gross mucosal ulceration was noted in 11

TABLE 1.—POSITION OF THE ENDOMETRIAL GLANDS AND STROMA IN ENDOMETRIOMA OF THE BOWEL FROM THE CURRENT SERIES

Case	Segment of bowel	Submucosa		Muscularis		Serosa	
		Glands	Stroma	Glands	Stroma	Glands	Stroma
1	Ileum	+	+	+	+	+	+
2	Ileum	0	0	+	+	+	+
3	Sigmoid	+	+	+	+	0	0
4	Ileum	0	0	+	+	+	+
5	Sigmoid	+	+	+	+	0	0
6	Sigmoid	0	0	+	+	0	0
7	Sigmoid	0	0	+	+	0	0
8	Sigmoid	+	+	+	+	+	+
9	Sigmoid	+	+	+	+	0	0
10	Sigmoid	+	+	+	+	+	+
11	Rectosigmoid	+	+	+	+	+	+
12	Rectosigmoid	+	+	+	+	+	+
13	Sigmoid	+	+	+	+	+	+
14	Sigmoid (vacuous)	—	—	+	+	+	+
15	Rectosigmoid	+	+	+	+	+	+
16	Sigmoid	+	+	+	+	+	+

+ = positive 0 = negative — = not stated.

of the 16 cases the mucosa was more or less firmly adherent to the underlying submucosa and to the muscularis propria. Irregular puckering of the peritoneal coat was noted in all of the lesions.

Proximal segments. In all of the specimens in which accurate luminal dimensions could be studied the bowel proximal to the obstruction showed the effects of stasis in the form of dilatation (Fig 1). In 11 cases this degree of dilatation was estimated to be two or more times the luminal diameters distal to the endometriomas. This obstructive dilatation moreover was paralleled in a general way by increases in thickness of the muscularis propria. In 9 of the specimens this layer was approximately doubled in thickness.

Associated pathologic conditions. Uterine fibromyomas had been noted at operation or removed in 8 of the 16 cases. Six patients had extensive ovarian endometriosis with tarry cysts. Four patients had simple ovarian cysts and the ovaries and tubes of an additional 2 were involved in adhesions. If in addition we consider that 9 patients had pre-

viously undergone surgical exploration of the pelvis it becomes apparent that the obstruction of the bowel by endometriosis was but a part of the picture.

MICROSCOPIC FEATURES

In essence the intestinal lesions consisted in invasion by endometrial glands and stroma of the serosa, muscularis, submucosa, and mucosa in variable combinations (Table 1). Added to this was the important factor of reactive fibrosis with stenosis resulting from the contraction of maturing fibrous tissue. Since the process was fundamentally extrinsic in point of origin mucosal changes were the least frequently noted. In 4 instances the endometrial glands and stroma invaded the muscularis mucosae and in 1 of these a microscopic-sized area of ulceration involved the overlying epithelium. Considerable mucosal scarring was present. Infiltration of the submucosa obtained in 11 instances (Fig 3). All specimens showed infiltration of the muscularis propria. All 3 specimens of ileal endometriosis showed a major concentration of endometrial glands and stroma in the serosa and outer muscular coats. In contrast the sigmoidal and high rectal lesions were generally of the "deep" type—that is, the inner circular layer of muscle and the submucosa exhibited the greatest number of these ectopic elements. As a matter of fact in 5 cases of well circumscribed endometriosis of the sigmoid routine sections failed to reveal the presence of serosal endometriosis, although one certainly might concede that it had existed earlier in the course of the invasive process.

Although the proportion of endometrial glands to stroma varied a great deal (Fig 3), in general these elements were present in about equal proportions. The glandular and stromal elements were in all cases similar to their normal intrauterine counterparts and they exhibited pictures typifying all the phases of the menstrual cycle. Within the musculature of the bowel the endometrial glands seemed to proliferate in an axis parallel to that of the muscle bundles (Fig 4) as though the invading tissue were following the lines of least resistance rather than per-



Fig. 2 Gross specimen (Case 16) of sigmoid which is doubled on itself. Note the large endometrioma (5 by 5 by 3 cm.) in its midportion which has impinged on the intestinal lumen to obstruct it.

Fig. 1 Gross specimen (Case 1) of terminal ileum, cecum, appendix, and ascending colon. Note endometriosis causing obstruction at a point 5 centimeters proximal to the ileocecal valve and the dilatation of the bowel above this point.

ing lymphatic spaces. The presence in 6 cases of cystic glandular hyperplasia was correlated with a clinical history of *menstrual irregularity* noted in the histories.

Studies made using the van Gieson stain for fibrous tissue revealed in all instances fibroblasts and collagenous fibrils around the nests of endometrial glands and stroma (Fig. 5). This fibrous tissue was occasionally hyalinized. In both the fibrous and the hyalinized examples this reaction tissue was seen to infiltrate the invading glands and stroma on the one hand and the invaded muscular tissues on the other.

Stains for iron demonstrated the presence of this substance in 5 instances only. This was something of a surprise since we had surmised that the concentration would obtain on the basis of a reaction to hemosiderin deposited during menstruation from the ectopic endometrium.

COMMENT

Endometriosis is the only common condition in which there occurs invasion of one tissue by another normal tissue of the same

host.^{1,2} When the bowel is the victim of this infiltrative process the segments affected are usually those which are situated in the pelvis. These are the sigmoid, the rectosigmoidal juncture, the rectum, and the distal portion of the ileum. As with endometriosis elsewhere the survival of the lesions is predicated on the influence of the cyclic hormonal stimulation of the ovaries. In the absence of this stimulation endometriosis undergoes retrogression. Endometriosis invades the intestinal wall from its serosal side and grows inward into the muscular layers and the submucosa (Fig. 6). Rarely may the mucosa of the bowel be invaded grossly (Fig. 7).

Sampson's implantation hypothesis plus Harbitz' idea of extraperitonealization will explain the pathogenesis of endometrioma of the sigmoid and ileum, while an equally good alternative hypothesis is that of lymphatic and venous metastasis (7, 31).

The frequency with which the diagnosis of endometriosis (35) is made by the clinician, the surgeon, or the pathologist varies with their threshold of suspicion, and it is our feeling that many cases have passed unrecog-

¹Traumatic rupture of the spleen is occasionally followed by a peritoneal seeding of splenic transplants.

²The placenta might be considered to be an exception, depending on the interpretation of the word "host."



Fig. 3 Sigmoid (Case 3) Endometrial glands and stroma are seen in the submucosa. Note variation between amount of glands and stroma present (hematoxylin and eosin $\times 57$)



Fig. 4 Sigmoid (Case 5) Note that the long axis of the muscle fibers runs parallel to the long axis of the endometrial glands (hematoxylin and eosin $\times 37$)



Fig. 5 Sigmoid (Case 3) Note the endometrial glands in inner muscular layer with fibrosis around them (van Gieson $\times 83$)

nized. The truth of this statement is also applicable to the complication of intestinal obstruction caused by endometriosis since against our series of 16 cases a "literature" of only 40 cases seems inadequate.

The symptoms of intestinal obstruction caused by endometriosis may be divided into two main groups: (1) the symptoms and signs of usually extensive pelvic endometriosis and (2) the symptoms and signs of intestinal obstruction in its various degrees.

Endometriosis occurs in women usually between the ages of 30 and 50 years. The majority of the women are sterile. More than half of the women have never been pregnant¹ and at least two-thirds have never carried a fetus through to full term delivery.

A periodicity of symptoms associated with the menstrual cycle and the onset of menstruation is the single most important sign of endometriosis *per se* and its complication of intestinal involvement. This periodicity of symptoms includes both the symptoms of

¹This too may depend on the physician "threshold of suspicion" in the search of the patient's past history.



Fig. 6 Sigmoid (Case 5) Endometrial glands and stroma are seen in the submucosa. Of significance is the fusion in a scarred area of the muscularis mucosae and propria (hematoxylin and eosin $\times 70$)

Fig. 7 Sigmoid (Case 8) Note ulceration of the mucosa (rare and not characteristic) and the presence of endometrial glands and stroma. The muscularis mucosae is thickened and fibrosed (hematoxylin and eosin $\times 70$)

endometriosis and those of intestinal obstruction. A history of the symptoms of acquired dysmenorrhea, rectal pain associated with or between defecations, sacral pain or deep pelvic pain or discomfort (which may extend down into the thighs and is made worse by jarring), severe constipation or diarrhea, and dyspareunia that are increased just before during or just after menstruation is usually indicative of extensive endometrial involvement of the sigmoid, rectosigmoidal juncture or rectum. When these symptoms become progressively worse and lengthen out in duration premenstrually, postmenstrually or both, obstructive intestinal symptoms are usually imminent.

The symptoms of intestinal obstruction then become superimposed on those of endometriosis of the bowel at first usually only comenstrually. These symptoms for the sigmoid and below are those of lower abdominal pain (which is one of the first to be present) along with abdominal distention and finally obstipation which may be present for only 1

or 2 days during the period. When the sigmoid or more distal portions of the bowel are obstructed, nausea and vomiting usually occur late because of the competence of the ileocecal valve (45). Occasionally a reflex type of nausea and vomiting may be encountered. The symptoms of the endometriosis plus the superimposed symptoms of the intestinal obstruction which at first are mild, become progressively worse, lengthen out premenstrually or postmenstrually and either go on to the production of acute complete or partial obstruction at one of the menstrual periods or assume the form of chronic intermittent partial obstruction of high or low grade.

Compared with intestinal obstruction in general caused by endometriosis, ileal obstruction caused by endometriosis more often occurs among younger women who usually have less extensive pelvic involvement by endometriosis or sometimes no other grossly visible pelvic involvement. These patients may or may not have the general symptoms of endometriosis but when these symptoms are

A roentgenologic examination of the colon is assuming a rôle of importance in the diagnosis of endometriosis causing intestinal obstruction. If the obstruction is complete the employment of a roentgenogram of the colon may accurately localize the lesion. If the obstruction is incomplete the proper interpretation of the roentgenogram of the colon may not only localize the obstructing lesion but identify the cause as endometriosis as well. The characteristic lesion on roentgenologic examination of the colon is said to be a long inconstant filling defect with sharp regular borders intact mucosa and fixation of the bowel which is very tender to palpation.

Diagnosis. The diagnosis of intestinal obstruction which has been caused by endometriosis or endometrioma may best be made by first obtaining an accurate history of the development of the symptoms which are diagnostic of endometriosis. Points of importance are as follows: (1) a woman in the reproductive period of life, usually between the ages of 30 and 50 years; (2) who is in fairly good general health and has not lost weight; (3) who suffers from absolute relative or secondary sterility or who has married late or has not been pregnant for some time; (4) who has acquired dysmenorrhea; and (5) who has a history of usually a year or longer of symptoms which occur with menstrual periodicity: (6) symptoms such as severe constipation, rectalgia or dyschezia, dyspareunia, occasionally diarrhea, and rarely rectal bleeding; (7) low deep pelvic discomfort caused by jarring of the body; (8) sacral backache which may run down into the thigh; and (9) symptoms of intestinal obstruction such as lower abdominal cramping colicky pain, abdominal distention and obstipation or vomiting or both which have shown menstrual periodicity and become progressively more severe.

These symptoms plus the finding of (1) on pelvic examination tender nodules in the pouch of Douglas or a large tumor of the rectovaginal septum and associated uterine fibroids and bilateral ovarian cysts; and (2) a sigmoidoscopic examination that shows an intact puckered mucosa and a stenosed or narrowed intestinal lumen from an extrarectal mass; or (3) a roentgenogram of the colon that shows a



Fig. 9. Sigmoid (Case 16). Note the large cyst in the submucosa and the invasion of the submucosa and muscular layers by endometrial glands and stroma in the late differentiative phase (hematoxylin and eosin $\times 9$).

long inconstant filling defect with regular borders intact mucosa and fixation of a tender bowel indicate a highly presumptive diagnosis of intestinal obstruction caused by endometriosis. Positive diagnosis can be made only by operation and surgical biopsy of the lesion with frozen section and microscopic pathologic confirmation.

Treatment. 1. Surgical treatment.—The treatment of intestinal obstruction caused by endometriosis is surgical. The basic principle in the treatment of this condition is the fact that retrogression of endometriosis depends on the absence of ovarian hormonal stimulation. Hence to treat the patient the surgeon may elect usually to remove both ovaries¹ (as pointed out by Milnor and others) or occasionally to resect the bowel (30) or in rare instances to do both. Factors to be considered by the surgeon are the age of the patient, her desire to become pregnant, the probability of

Radiation castration could not be expected to produce rapid regression of the obstructing intestinal lesion. Surgical castration alone on the other hand is often followed promptly by the relieving of serious obstructive symptoms.



Fig. 8. Sigmoid (Case). Note the island of endometrial glands and stroma, the late differentiative phase of the subserosa (hematoxylin and eosin $\times 66$).

present it is usually to a lesser degree. This is represented by the facts that the group with ileal involvement had a higher fertility rate, fewer previous pelvic operations, fewer uterine fibroids and a lesser incidence of associated pelvic pathologic changes. Also in the ileal group no patient had rectal pain, constipation was less frequent, only 1 patient complained of diarrhea and no patient had blood in the stools. Vomiting was a more frequent symptom than obstipation.

Often according to the literature, and once in the current series, obstruction of the distal portion of the ileum by endometriosis has been diagnosed clinically as appendicitis accompanied by paralytic ileus. If however the history is taken carefully the symptoms of the endometriosis are usually elicited. Definite symptoms of low ileal obstruction are superimposed on the periodic menstrual symptoms of acquired dysmenorrhea, constipation and so forth.

Gross blood in the stools is usually not an important symptom of endometriosis of the bowel. It is of significance only when other

anorectal lesions have been excluded and when it is present only at the menstrual period.

Valuable adjuncts to the symptoms in the diagnosis of intestinal obstruction as caused by endometriosis are digital examination of the vagina and rectum, the sigmoidoscope and roentgenographic examination of the colon and the terminal portion of the ileum after administration of a barium enema.

Pelvic examination most often reveals tender palpable nodules in the rectovaginal septum or the pouch of Douglas, frequently the presence of associated uterine fibroids and in many cases the presence of ovarian cysts, usually bilateral. On operation these are most often observed to be the chocolate cysts of endometriosis. Pelvic examination is best made just before or during menstruation because of increased tenderness and congestion. If a discrete endometrioma is present in the rectovaginal septum it may be palpated. A thorough search of the vaginal vault via a speculum at the time of menstruation may reveal the presence of the purplish pink lesions of endometriosis which have invaded the vaginal wall. The vaginal wall may sometimes be invaded but the rectal mucosa almost never is.

On sigmoidoscopic examination there is rarely gross bleeding and almost never gross ulceration. The positive findings will be those of a greatly narrowed lumen, an anterior extrarectal mass, acute angulation of the bowel and mucosal puckering and congestion. The appearance is much like that of obstructing diverticulitis and cannot be positively differentiated from it by means of the sigmoidoscope but the intact mucosa differentiates it from carcinoma. Biopsy of the intestinal mucosa is usually not practical for since the mucosa is not extensively involved the report will usually come back negative or "inflammatory change only." Even in the few cases in which rectal bleeding has been a symptom the mucosa has appeared only puckered or adherent but not ulcerated and fairly normal. It is important to remember that carcinoma invades the intestinal wall from the mucosa outward while endometriosis invades it from the serosa inward.

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her becoming pregnant, the existence of associated pelvic pathologic lesions and the location and extent of the endometriosis together with the degree of intestinal obstruction present. Decision to do a conservative operation implies that the surgeon must be sure that the intestinal lesion is *not* in fact a carcinoma.¹ Because the treatment of intestinal obstruction varies with the location of the lesion the therapy of colonic obstruction will be discussed first followed by that of ileal obstruction.

a Treatment when the point of obstruction is in the sigmoid rectosigmoidal junction or rectum.—In these cases the involvement of the pelvis and colon by endometriosis is usually extensive and bilateral oophorectomy or panhysterectomy is usually indicated. Panhysterectomy is justified because the endometrioma of the colon will retrogress the obstruction will be relieved and associated pelvic lesions, which are nearly always present will be removed. If the obstruction is complete or incomplete with much dilatation of the proximal portion of the bowel temporary proximal colostomy should also be done to decompress the bowel. The stoma may be closed in a few months after subsidence of the endometrioma. If the patient is a young woman who is desirous of a pregnancy and whose pelvic organs are essentially normal resection of the involved segment of the bowel is the procedure of choice.

b Treatment when the point of obstruction is in the ileum.—In these cases the treatment of choice is resection of the bowel or if the diagnosis is apparent to the surgeon a short-circuiting procedure. The obstruction in these cases is to some degree caused by the partial occlusion of the lumen by the endometrioma but more by the tough dense adhesions of endometriosis and resultant kinking of the bowel.

2 Surgical treatment versus roentgen therapy.—Roentgen therapy should be reserved for those patients who are extremely poor operative risks or who have had intestinal recurrence of endometriosis following operations in which conservative treatment was given to the ovaries.

¹Chiefly among cases found early in our series, the surgeon felt reasonably certain that the intestinal lesion was malignant.

Presumable relationship of endometriosis to carcinoma. The question whether carcinoma may develop from endometriosis or on the basis of it has been much debated (p. 42). It is our conclusion that a *presumable* relationship may exist but there is no definite *factual* proof of it.

SUMMARY AND CONCLUSIONS

1 An analytic study of clinical data on it from the current series of cases of intestinal obstruction caused by endometriosis has been presented as well as the results of a pathologic study of these cases.

2 To make the diagnosis of endometriosis as a cause of intestinal obstruction, the possibility of its occurrence should be kept in mind in every case of intestinal obstruction in which the patient is a woman from 30 to 50 years of age. Acquired dysmenorrhea, menstrual periodicity of symptoms, sterility, rectal or pelvic pain, absence of loss of weight, the presence of associated uterine fibroids or ovarian cysts, and a long history of intestinal symptoms which suggest progressive intestinal obstruction with frequent exacerbations at menstruation are most important points in the diagnosis of this condition.

3 Severe constipation, lower abdominal pain and distention are almost always present. If the obstruction is ileal vomiting is almost always present while if the obstruction is colonic obstipation is more often present. Diarrhea is occasionally a symptom but the presence of gross blood in the stool in the absence of other anorectal disorders is very infrequent. If present at the time of menstruation it is of significance.

4 The symptoms of menorrhagia and metrorrhagia are not the symptoms of endometriosis *per se* but rather the symptoms of associated pelvic pathologic lesions.

5 An accurate preoperative diagnosis of intestinal obstruction caused by endometriosis can usually be made on the basis of the clinical history, digital examination, sigmoidoscopic examination and careful interpretation of the roentgenogram of the colon and the terminal portion of the ileum. The finding of a firm tumor in the rectovaginal septum or of tender palpable nodules plus the

palpation of uterine fibroids and bilateral ovarian cysts is suggestive of endometriosis as the cause when intestinal obstruction is present. Sigmoidoscopic examination with the presence of an extrarectal mass and an intact puckered mucosa and a roentgenogram of the colon with the presence of a long in constant filling defect with sharp regular borders and an intact mucosa are the two most valuable adjuncts to diagnosis when the lesion is in the lower bowel.

6. Surgical biopsy of tissue from the vaginal vault if the endometrioma is in the rectovaginal septum and has invaded the vaginal mucosa may afford pathologic confirmation of the clinical diagnosis but biopsy of the rectal mucosa is usually noninformative as the tissue in all the cases in which this was done in the current series was reported as inflammatory.

7. Obstruction of the ileum as caused by endometriosis presents a less characteristic clinical picture than that in the sigmoid or below.

8. The treatment of intestinal obstruction caused by endometriosis is surgical. A preoperative diagnosis of endometriosis as a cause of colonic obstruction will obviate the necessity for resection of the bowel in most instances and surgical treatment will consist usually of bilateral oophorectomy or of partial hysterectomy with or without temporary colostomy as is deemed necessary. The procedure of choice in obstruction of the ileum caused by endometriosis is ileal resection with or without preliminary enterostomy and with or without panhysterectomy as indicated by the presence and degree of associated pelvic pathologic lesions.

9. The mechanism of ileal obstruction was usually due to kinking caused by the endometriosis, while the obstruction in the sigmoid and below was more often due to an impingement of the endometrioma into the intestinal lumen.

10. If the patient is a young woman who has a discrete endometrioma of the ileum or sigmoid causing intestinal obstruction if the pelvic organs are essentially normal to the extent that there appears to be a reasonable chance of an ensuing pregnancy and if the

absence of menorrhagia or cystic endometrium has indicated evidence of fair ovarian function a conservative operation should be done as regards the ovaries and a radical operation done as regards the obstructed bowel. In intestinal resection without oophorectomy is indicated.

11. Microscopically endometrial glands and stroma were found in all layers of the intestinal wall (Figs 8 and 9). They seemed to be most diffusely dispersed in the muscular layers. The endometriomas of the sigmoid were of the discrete or deep type while the endometriomas of the ileum were located closer to the serosa.

12. Gross blood had been present in the stools of only 3 of 16 patients. The intestinal mucosa on gross inspection was intact in all cases but on microscopic examination it was invaded by endometriosis in 2 cases. In 1 of these cases microscopic ulceration had occurred.

13. Fibrosis around the endometrial glands and stroma was characteristic in all of the sections but a positive iron stain representative of hemosiderin was not characteristic. The muscle fibers in most instances seemed to run in the same long axis as that of the endometrial glands.

14. A plea is made for biopsy, frozen section and pathologic confirmation of the clinical diagnosis in all cases of endometrioma obstructing the bowel as carcinoma can be positively excluded only by this method. The prognosis of patients who have had intestinal obstruction caused by endometriosis is excellent and the surgical mortality rate was nil in the current series.

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FRACTURES OF THE TIBIAL CONDYLES INVOLVING THE KNEE JOINT

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AN increasing agreement prevails among bone and joint surgeons that fractures involving joints especially weight bearing joints should be restored to normal anatomical relationship as accurately as possible and if necessary by surgical measures. This viewpoint applies particularly to fractures of the tibial condyles involving the knee joint. There are some authors who believe that for the most part these fractures can be handled reasonably satisfactorily by manipulative measures. Watson Jones would operate upon only the severely displaced condyles and would treat the majority of these fractures by manipulation. He has emphasized the likelihood of a poor result following any form of treatment of many of the badly comminuted fractures of the tibial condyles. E. M. Bick reported good functional results in 61 cases following nonoperative treatment. The majority of writers however Foged Leadbetter and Hand Buckner Ronald Palmer Barr and Knight believe that the fractures of the tibial condyles with any degree of displacement particularly the "bumper" fracture of the lateral tibial condyle are best treated by open reduction and internal fixation.

At the Massachusetts General Hospital from which this series of cases is reported we believe that like any other type of fracture each fracture must be evaluated as an entity and treated accordingly. Those fractures with little or no displacement can usually be handled by conservative measures namely manipulation followed by fixation or traction while many of those with gross displacement and separation and depression of the tibial condyles had best be operated upon but only by a skilled surgeon trained in meticulous joint surgery.

The commonest most difficult to handle and consequently the most important fracture involving the tibial condyles is the "bumper

or fender fracture which produces major damage to the lateral tibial table with or without damage to the external semilunar cartilage the internal lateral ligament and the cruciate ligaments (Fig 1). This fracture is practically always sustained by a force which sharply adducts and flexes the knee and in so doing compresses the external semilunar cartilage strains or tears the internal lateral ligament or the cruciate ligaments or both and at the same time depending on the severity of the force impacts the lateral femoral condyle against the lateral tibial condyle producing a compression fracture of the lateral tibial condyle which in many cases is severely comminuted. The maximum compression of the tibial condyle may be posterior to the midline because the most prominent curve of the femoral condyle occurs at this point.

In our cases the following were some of the causes of this type of fracture a blow by the bumper or fender of an automobile on the outer side of the knee a fall from a ladder landing with the knee flexed and adducted a blow on outer side of the knee from a charging steer in one case a large dog in another. In all adduction and flexion of the knee were involved and in all cases too there were varying degrees of injury and subsequent reaction in the joint.

While fracture of the lateral condyle is the commonest injury involving the tibial condyles others may occur depending upon the mechanism of injury. If the blow is received on the inner side of the knee fracture of the medial tibial condyle may occur with injury to the internal semilunar cartilage and to the external collateral ligament of the knee as occurred in the following case a young man of 21 while attempting to bulldog a steer was apparently struck on the inner aspect of the knee. There was immediate pain and disability and when the patient was seen 5 days later roentgenograms revealed a separation and de-

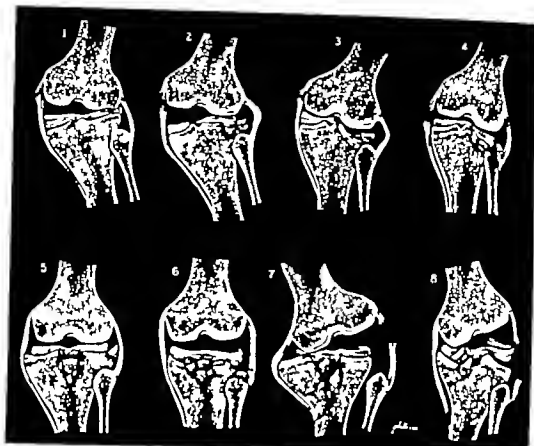


Fig. 1. Mechanism of injury in various types of tibial plateau fractures. Flexion and adduction of knee—strain of internal lateral ligament and compression of external semilunar cartilage. 2 and 3, Flexion and adduction of knee—injury to internal lateral ligament and probably cruciate ligaments. With compression of external semilunar cartilage and comminuted fracture of the lateral tibial condyle. 4, In addition to injuries 2 and 3, there is also fracture of the fibula head. 5 and 6, Bursting fracture of both condyles, usually sustained by fall from a height. 7 and 8, Flexion and abduction of knee—injury to external lateral ligament and probably cruciate ligaments—also injury to internal semilunar cartilage and comminuted fractures of internal tibial condyle.

pression of the medial tibial condyle. No attempt was made to manipulate this fracture but 7 days after injury the internal tibial condyle was replaced to its normal position and held with a tibial bolt. The end result was a knee which allowed the patient to drive an ambulance during most of the war. The knee was stable, had good alignment, with complete extension and flexion to 100 degrees.

Bursting fractures of both condyles may occur from very severe trauma either from a heavy blow or from falls from a great height. It is questionable whether this type of severely comminuted fracture can be sufficiently restored to justify open operation and our belief is that these markedly comminuted ones possibly should be treated with gentle manip-

ulation attempting to compress the fragments into more normal alignment with the hands of the operator or by specially devised clamps. Such compression clamps cannot be used without danger and not infrequently when operating upon tibial plateau fractures which have been unsuccessfully treated by using the clamp we have found that more comminution of the fracture has been produced and fragments of articular cartilage and semilunar cartilage had been compressed further into the tibial head. If manipulation and compression are used they should be followed by skeletal traction in the form of a Kirschner wire through the os calcis or lower end of tibia (Fig. 2). No matter what treatment is applied to these severely comminuted fractures, it is like-



Fig. 2. Anteroposterior and lateral views before and after treatment of a bursting fracture involving both tibial condyles and the upper tibial shaft. This type of fracture is best treated by gentle molding with the hands of the

operator and skeletal traction (Kirschner wire through os calcis) for 6 or 8 weeks followed by immobilization in plaster for 6 weeks and walking with crutches for 4 or 5 months after injury. Open reduction is contraindicated.

ly that some patients will eventually develop extensive traumatic changes resulting in arthritis of varying degrees. In such cases the wearing of permanent external support or an arthrodesis of the knee are probabilities.

In discussing pathological findings, symptoms and signs and x-ray findings we shall describe particularly the "bumper fracture" because it is the classical fracture involving the tibial condyles.

PATHOLOGICAL FINDINGS

There is immediate swelling of the joint due to hemorrhage and increased synovial fluid. Fat droplets will be present in the fluid if the fracture involves the subchondral area. The swelling will increase for 24 or 48 hours. There is always more or less damage to the internal lateral and cruciate ligaments and compression usually of the lateral tibial table and not infrequently also the fibular head. The degree of comminution, depression and separation of the fragments varies. More often than not the lateral semilunar cartilage is injured and may be displaced downward into the spongy bone of the main fracture line along with fragments of the articular cartilage of the central portion of the lateral condyle. In the most severe cases actual subluxation of the knee joint due to the extensive ligamentous injury may be present.

SYMPTOMS AND SIGNS

Pain is most marked on the inner aspect of the knee due to the unusually severe injury to the internal lateral ligament chiefly at its femoral attachment. If the degree of fracture is not great the patient may walk with assistance but if the depression of the lateral condyle is marked there will be complete disability. The knee will be held in a position of protection of 25 to 50 degrees of flexion and more or less knock knee position depending upon the degree of depression of the lateral tibial condyle. All active and passive motions will be severely painful and palpation will reveal marked joint line tenderness and particularly severe at the femoral attachment of the internal lateral ligament. Damage to the popliteal structures and the peroneal nerve is rare but should always be suspected.

X-RAY STUDIES

Roentgenograms of both knees should be taken in the same relative position with an anteroposterior, lateral and oblique views. If the injured knee is held in a position of flexion the normal knee should be roentgenographed in the same position. Little knowledge is gained from the lateral views while the anteroposterior and oblique views will reveal the diagnosis. Because of the soft tissue swelling

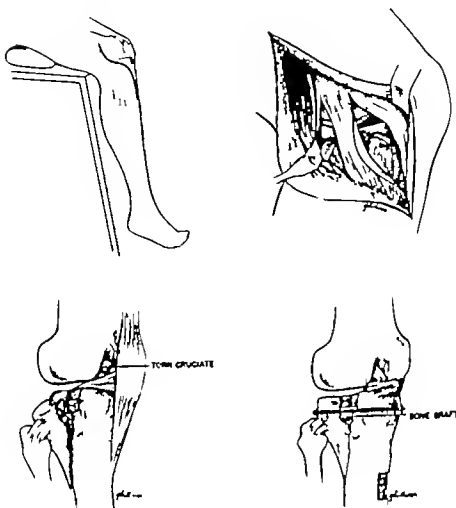


Fig. 3. Technique of operation

more than the usual x ray penetration should be used to demonstrate the fracture lines.

TREATMENT

For the severely depressed fracture of the lateral condyle it is difficult for us to see how such a fracture can be replaced by manipulative means with any degree of accuracy. Therefore we usually employ the following operation (Fig. 3). The lateral aspect of the knee is exposed with a bayonet incision beginning just posterior to the lateral femoral epicondyle about 3 inches above the joint line and curving forward at the joint line and down along the lateral portion of the tibial crest for 4 inches. The joint is opened anterior to the external lateral ligament with a curved in-

cision and posterior to the ligament and popliteus tendon with a perpendicular incision. The upper tibia is exposed subperiosteally back to the tibiohular ligament. Usually the semilunar cartilage is displaced downward into the fracture line and therefore it must be removed in order to visualize the fracture and also to effect reduction. The displaced lateral portion of the tibial table is osteotomized and turned outward and the depressed fragments elevated to their normal position. It may be necessary to remove some of the small fragments of articular cartilage which have little chance of survival. The main lateral fragment or fragments are then apposed to the tibia and secured by a long bolt with a tap on the inner end to maintain reduction. We must admit



Fig. 4. Preoperative and postoperative views of a typical "bumper" or depressed fracture of the lateral tibial condyle. The external semilunar cartilage which was depressed into the main fracture line was removed the

depressed "central" fragments were elevated and held in position with a graft which was taken from the lateral tibial crest, and the fractures were stabilized with a bolt and screw.

that extensive comminution of the fracture makes the procedure difficult. If this is the case a tibial bone graft removed from the anterior portion may be driven under the joint surface to preserve the tibial plateau (Fig. 4). We have not found it necessary to suture any of the internal lateral ligaments nor would we advise attempting to repair damaged cruciate ligaments at the time of reduction of the fracture. In only one case in our series was there severe damage to the cruciate ligaments which resulted in luxation of the knee and a poor functional result was obtained because of instability of the joint in spite of the fact that the fracture was well reduced by operation. If the mesial condyle rather than the lateral has been displaced the bayonet incision must be placed on the inner aspect of the knee in which case care should be exercised to preserve the internal saphenous nerve.

Whether plaster immobilization or suspension in a hinged splint should be used after operation is optional. We believe that if the fracture or fractures have been well stabilized by the bolt suspension is sufficient. Early exercises can be carried out in the splint and at the end of a 6 weeks period the patient is allowed up on crutches and with little weight bearing in a light hinged brace to prevent any tendency to valgus deformity of the knee.

If the fracture is a simple not comminuted one it is possible that manipulation and com-

pression followed by plaster will be sufficient for the minor displacements or depressions or both manipulation and plaster fixation may improve the situation. As in all fractures of weight bearing joints delayed weight bearing must be practiced. Crutches must be used for a period of 2 to 6 months depending upon the severity of the injury. Any tendency to valgus position of the knee must be prevented by the use of a hinged brace and Thomas heel.

ANALYSIS OF CASES FROM THE MASSACHUSETTS GENERAL HOSPITAL

From 1930 to 1945 inclusive we treated in our clinic a total of 69 fractures of the tibial condyles involving the knee joint. An earlier series of 29 cases from 1923 to 1930 was reported by Barr (10) in the Massachusetts General Hospital Fracture Book making a total of 98 cases.

In the 1923 to 1930 series of 22 end result cases 17 were treated by nonoperative means and only 5 by surgery, one operation being an arthrodesis for painful traumatic arthritis and 2 were compound fractures and simply debrided thus leaving only 2 simple fractures treated by open reduction and internal fixation. In the more recent series 1930 to 1945 40 patients were treated by nonoperative means and 29 were subjected to surgery. Many of the 40 patients in the nonoperative group presented minor fractures with a clinical pic-

TABLE I — TYPES OF INJURY SUSTAINED IN 29 MAJOR FRACTURES INVOLVING THE TIBIAL CONDYLES

Lateral tibial condyle and head of fibula
Lateral tibial condyle
Medial tibial condyle
Medial tibial condyle and head of fibula
Lateral tibial condyle compound and comminuted
Lateral tibial condyle old
Removal of bolt
Excision bone cyst
Excision lateral meniscus
Excision bone sequele

Total

—
29

TABLE III — END RESULTS IN 24 FRACTURES TREATED BY OPEN REDUCTION AND INTERNAL FIXATION

Cases	A 4	B 4	F 4
7	A 4	B 4	F 3
14	A 3	F 4	F 3
1	A 3	E 4	F 4
1	A 3	F 3	F 3
2	A 3	E	F 3
4	A 2	F 3	F 3
	A 2	E 4	F 2

Rating from 0" to 5" 6" 7" 8" 9" 10" 11" 12" 13" 14" 15" 16" 17" 18" 19" 20" 21" 22" 23" 24" 25" 26" 27" 28" 29" 30" 31" 32" 33" 34" 35" 36" 37" 38" 39" 40" 41" 42" 43" 44" 45" 46" 47" 48" 49" 50" 51" 52" 53" 54" 55" 56" 57" 58" 59" 60" 61" 62" 63" 64" 65" 66" 67" 68" 69" 70" 71" 72" 73" 74" 75" 76" 77" 78" 79" 80" 81" 82" 83" 84" 85" 86" 87" 88" 89" 90" 91" 92" 93" 94" 95" 96" 97" 98" 99" 100"

The use of the letters A, F, E, signifies anatomic result, functional result, economic result

ture of ligamentous strain only and did not require prolonged treatment. Of the 29 operative cases in the latter series 16 were male and 13 female with an average age of 47 years. Table I shows types of injury in the 29 cases.

Of the 29 cases 22 were simple fresh fractures suitable for open reduction and internal fixation. We add to these 2 similar cases from the 1923 to 1930 series making a total of 24 (Table II).

In comparing the two series of cases it is obvious that there has been an increasing tendency in our clinic to treat displaced fractures of the tibial condyles by surgical means. This has happened for 2 reasons (1) we believe that most of these fractures cannot be reduced by manipulation and (2) the improvement in operative technique by members of the Fracture Clinic during the past 10 or 15 years.

We are still not satisfied with some of our anatomical repositions. These partial failures have been due to the inexperience of some of the operators and to the severe comminution of some of the fractures. In the 1923 to 1930 series of 2 operative cases both patients obtained excellent results and were rated A 4 E-4 F 4. In the 22 patients operated upon in

1930 to 1945 21 were restored to their former economic status and 18 had acceptable results, from an anatomical and functional standpoint.

CONCLUSIONS

1. Many fractures of the tibial condyles with more than a moderate degree of displacement should be treated by open reduction and internal fixation.

2. The surgeon undertaking such an operation must be well trained in meticulous joint surgery.

3. Preliminary manipulation and compression of many fractures of the lateral and medial tibial condyles may do harm to the joint surface of the tibia and make the subsequent open reduction more difficult.

4. Extensive comminuted fractures involving both tibial condyles may not be successfully reduced either by closed manipulation or open reduction.

These conclusions are based on a study of 98 cases, of which 24 patients were treated by open reduction and internal fixation.

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TABLE II — OPERATIVE PROCEDURES USED IN 24 CASES OF OPEN REDUCTION AND INTERNAL FIXATION OF TIBIAL CONDYLE FRACTURES

Excision of semilunar cartilage reduction of fracture-bolt fixation	5
Excision of lateral semilunar cartilage reduction of fracture introduction of tibial bone graft, bolt fixation	5
Reduction of fracture screw fixation	4
Total	24

THE SURGICAL TREATMENT OF RECURRENT ACUTE PANCREATITIS BY ENDOCHOLEDOCHAL SPHINCTEROTOMY

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SURGICAL treatment of acute pancreatitis and especially of recurrent acute pancreatitis has been essentially palliative. Since 1901 when Opie focussed the attention of surgeons on the observation that acute pancreatitis could be produced by retrojection of bile into the pancreatic duct when the ampulla of Vater was occluded by a stone the investigations of many surgeons and physiologists have been directed toward this problem. The operation of cholecystostomy or choledochostomy is but a temporary expedient to reduce the possibility of further passage of bile into an organ in which the disease process had already reached its apogee. The removal of stones from the gall bladder and bile ducts in recurrent pancreatitis and the prolonged drainage of the biliary tract are intended to be preventative measures and are so when obstruction at the ampulla is due to stone. Cholecystectomy in the absence of stones was advocated by Judd (20) and others for three reasons: (1) the removal of a muscular organ would prevent the forceful propulsion of concentrated bile into the pancreatic duct; (2) the absence of concentrated gall bladder bile would diminish the severity of its necrotizing action since the severity of the process was shown by Flexner to depend partly on the bile salt concentration and (3) cholecystectomy often resulted in relative atony of the sphincter of Oddi as noted by others (9, 21). That this concept of Judd was justified was confirmed experimentally by Wangenstein on cats. Under his experimental conditions the incidence of acute pancreatitis was reduced 50 per cent by cholecystectomy.

However in all these operative procedures since the essential anatomy, a common pas-

sageway between the choledochus and the pancreatic duct remains unchanged it is obvious that the possibility of further obstruction due to factors other than stone might be anticipated. The recurrence of pancreatitis in patients after these operations confirms this fact.

The probability that attacks of acute pancreatitis might recur following the successful treatment of concomitant biliary tract disease was emphasized by the finding that in about 50 per cent of all cases of acute pancreatitis the biliary tract was found to be normal. A solution of this puzzle was furnished by Archibald who suggested in 1913 (1) that spasm of the sphincter of Oddi might produce sufficient temporary obstruction to enable bile to enter the pancreatic duct. He proved his case in 1919 (2) producing acute pancreatitis in cats by injecting bile into the biliary tract while temporary spasm of the sphincter was being induced by mechanical and chemical measures. Recent cholangiographic and kymographic studies on patients have confirmed his opinion that the human sphincter of Oddi was a highly labile muscle. Spasm of this muscle was occasionally found postoperatively (14, 16). Such drugs as morphine, local application of irritants such as hydrochloric acid and even the response to emotional stimuli could produce spasm of the sphincter in the human (Figs. 1, 2, 3). Further as a result of this spasm either found incidentally or produced by pain or drugs, lipiodol or other radio-opaque substances could be seen in cholangiographic studies to enter the pancreatic duct (Figs. 4, 5, 6, 7) when it joined the bile duct above the sphincter of Oddi.

Obviously if obstruction at the ampulla of Vater by spasm converts the bile and pancreatic ducts into a common channel leading to

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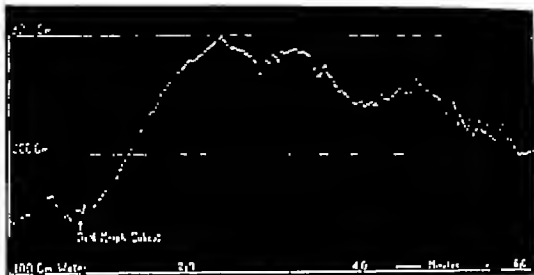


Fig. 1. Effect of morphine on the sphincter of Oddi. Kymographic tracing of the resistance of the human sphincter of Oddi shows that following the administration of $\frac{3}{6}$ grain of morphine the normal resistance of the sphincter (50 millimeters of water) rises to 300 millimeters and gradually subsides to 200 millimeters of water.

the production of acute pancreatitis the answer should be to cut the sphincter of Oddi or otherwise to destroy its function. However a number of factors have so far prevented the general acceptance of this procedure. Among these considerations may be mentioned the danger of opening the duodenum to cut the sphincter, the difficulty of cutting the sphincter with certainty transduodenally, and the fear that cholangitis might be produced by duodenal reflux as a result of its destruction. However the greatest deterrent to the adoption of this operation was the lack of complete conviction

among surgeons themselves to the effect that acute pancreatitis was attributable entirely to biliary reflux.

Aside from a few cases due to trauma, hematogenous infection, or interference with the blood supply to the organ by infarction or embolus, it was felt that acute pancreatitis might be produced by factors other than biliary reflux. Spread of infection from the gall bladder through the lymphatics (12) and intrapancreatic obstruction due to hyperplasia of the pancreatic duct epithelium (26) were also considered as etiological factors. Finally authentic cases were described in which acute pancreatitis was found in the absence of a possible common passageway between the biliary and pancreatic ducts since these opened separately into the duodenum (11, 19). However the consensus seemed to indicate that at least 60 per cent of all cases of pancreatitis were due to reflux of bile into the pancreas. Certainly most operative procedures were based on this assumption.

In recent years the conservative treatment of acute pancreatitis has gained almost general advocacy (17, 23, 24). In the great majority of cases this was made possible only by the development of the serum amylase test, by means of which the diagnosis could be made without exploratory laparotomy. The con-

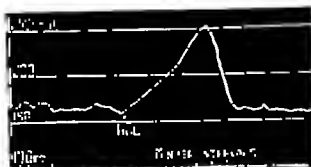


Fig. 2. Effect of 0.1 N normal hydrochloric acid (local application) on the sphincter of Oddi. Local installation of hydrochloric acid causes immediate spasm of the human sphincter of Oddi, the resistance to flow rising from 50 to 300 millimeters of water. The effect lasts for about 10 minutes or until the acid is washed away with water.

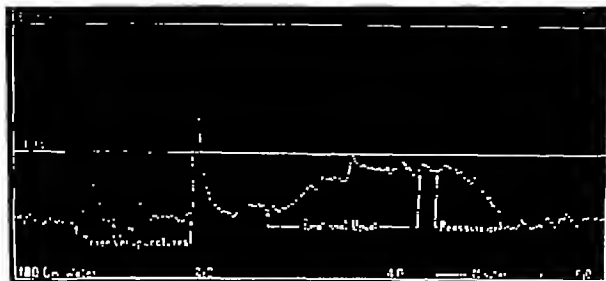


Fig. 3 Effect of pain and emotion on the tonus of the sphincter of Oddi. The insertion of a needle into the antecubital vein caused a marked rise in the tonus of the sphincter as a result of fear and pain. When the patient was reminded of the neglect of her only daughter she began to cry, and the tonus of the sphincter increased as the result of a feeling of hostility and resentment. When she was assured that her daughter had telephoned and would come to see her the sphincter could be seen to relax.

servative treatment led to a marked lowering of the mortality rate for acute pancreatitis. However, many of the patients who were thus treated and saved an operation returned for treatment because of recurrent attacks of acute pancreatitis, each attack carrying with it the possibility of either severe complications or a lethal outcome.

Two groups could be distinguished: (1) those with a normal biliary tract described in a classic paper by Comfort and his associates, and (2) those who had previous operations: removal of gall stones, cholecystostomy, or choledochostomy with drainage of the biliary tract for prolonged periods, cholecystectomy, or cholecystogastrostomy. It is these patients, several of whom will be described, who force us to consider the need for developing a definitive surgical procedure for their treatment.

CASE REPORTS

CASE 1. H. W. No. 58318-46, a 36 year old colored male with a 1 year history of recurrent attacks of severe epigastric pain accompanied by nausea and vomiting, was admitted to the Third (N. Y. U.) Surgical Division of Bellevue Hospital on December 2, 1946. Various diagnoses such as gastritis or duodenal ulcer had been made by different physicians. For the past 2 months he had been on a peptic ulcer regimen and had stopped drinking a habit to which he had been excessively addicted. However, on November 28, 1946, he had indulged in a large

Thanksgiving dinner including a number of alcoholic drinks and subsequently developed moderate epigastric pain which lasted until December 2, 1946. On this day he suffered a sudden onset of severe prostrating epigastric pain which radiated to the left shoulder and left groin. On admission to the hospital 8 hours later he was found to have generalized superficial abdominal tenderness with marked tenderness in the epigastrium on deep palpation. Temperature was 100 degrees, white blood count 13,400. A flat plate of the abdomen failed to reveal any free air in the subphrenic regions. The serum amylase carried out the day after admission was 260 milligrams per cent, and a diagnosis of acute pancreatitis was made. The amylase fell to 180 milligrams per cent the following day and to 161 milligrams per cent on the 4th day of the attack. By then his symptoms had disappeared and he was prepared for cholecystographic studies. That night he had a recurrence of pain and the following morning his serum amylase had risen to 302 milligrams per cent. Nevertheless he was given a routine fat meal after a preliminary x-ray examination and 2 hours later his serum amylase had risen to 387 milligrams per cent (Fig. 8). The cholecystogram revealed a normally functioning gall bladder. X-ray examination of his stomach and duodenum failed to reveal any abnormality. He signed out against advice on December 17, 1946 before further studies could be done.

CASE 2. O. T. No. 12709-47, a 44 year old white man was admitted to Bellevue Hospital on March 10, 1946, with complaints of severe epigastric and right upper quadrant pain, abdominal distention and vomiting. He gave a 12 year history of chronic alcoholism and an 18 month history of recurrent attacks of epigastric pain associated with bouts of acute alcoholism. He had been treated at a number



Fig. 4



Fig. 5

Figs. 4 and 5. Visualization of the pancreatic duct as a result of increased tone of the sphincter of Oddi. Incident spasm (Fig. 4) results in passage of injected iodized oil into the main pancreatic duct (on arrow) and thence into the accessory pancreatic duct of Santorini (two arrows). Pain produced by sudden distention of the common bile duct results in reflex spasm of the sphincter of Oddi and allows injected diodrast (33%) to pass up the pancreatic duct, completely outlining it to the tail (arrow).



Fig. 6



Fig. 7

Figs. 6 and 7. Visualization of the pancreatic duct as a result of spasm of the sphincter of Oddi produced by morphine. Following the administration of $\frac{3}{4}$ grain of morphine previously, the sphincter of Oddi became sufficiently spastic to enable the iodized oil to fill the whole pancreatic duct (arrow). In a patient whose gall bladder had been removed weeks previously, and the cystic duct drained. On slight rotation of the patient (Fig. 7) the junction of the ducts was clearly visualized.

of different hospitals where various diagnoses such as gastritis, cirrhosis of the liver, duodenal ulcer and delirium tremens were made. This last attack began suddenly 33 hours before admission following a meal

eaten after a bout of alcoholism and starvation lasting for 5 days. On admission he appeared acutely ill. His temperature was 98 degrees, white blood count 16,400. There was considerable abdominal disten-

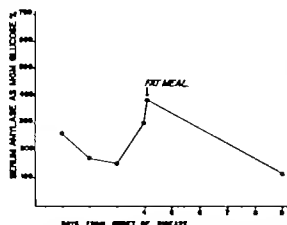


Fig. 8.

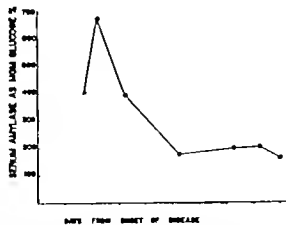


Fig. 9.

Figs. 8 and 9. The serum amylase test as an index of the progress of acute pancreatitis. In Case (Fig. 8) the serum amylase dropped to 61 milligrams per cent on the 4th day but following a fat meal there was a recurrence of symptoms and the serum amylase confirmed the recurrence of acute pancreatitis. In Case 2 (Fig. 9) the serum amylase indicated the gradual recovery from the disease.

tion and marked tenderness on deep palpation in the epigastrium and right upper quadrant. X-ray examination of the abdomen failed to reveal free air under the diaphragm. A serum amylase of 400 milligrams per cent established the diagnosis of acute pancreatitis. Under Miller Abbott tube suction and intravenous hydration and nutrition he improved rapidly, and his serum amylase although it rose on the 2nd day of admission gradually subsided (Fig. 9). He developed delirium tremens on the 3rd hospital day and was transferred to the psychiatric division. He improved under appropriate treatment. A cholecystogram showed an apparently normal gall bladder with rather poor concentrating power. X-ray films of the stomach and duodenum failed to reveal any abnormality. He signed out against a vice on April 1, 1947.

These 2 patients might conceivably do well on a regimen of frequent small meals and total abstinence from alcohol. However the danger of recurrent attacks one of which might be lethal would always be present. An operative procedure which would prevent biliary reflux if such an anatomical condition were present should be considered.

The following case illustrates many of the serious complications of recurrent acute pancreatitis one of which nearly led to death.

CASE 3. F. J. No. 51642-46, a 34 year old white male was admitted to Bellevue Hospital for the first time on October 30, 1946 with a 10 year history of recurrent attacks of severe epigastric and left upper quadrant pain associated with chills and fever. The attacks would last from 1 to 4 days occur frequently at irregular intervals although there were periods of 1 to 2 years when he was completely asymptomatic. On 2 occasions the attacks were so severe

that he was hospitalized. During a prolonged severe attack in 1944 the abdomen was explored and an acutely inflamed pancreas with the stomach duodenum and transverse colon adherent to it, was found. Cholecystostomy was performed and biliary drainage was carried out for 6 weeks. Up to the time of this last admission he had never felt quite well suffering from a dull aching epigastric pain and recurrent attacks of acute pain, chills and fever for which he received antimalarial treatment on several occasions in army hospitals. While under observation at Bellevue Hospital he developed a bilateral subphrenic abscess apparently due to rupture of an infected pancreatic cyst. These subphrenic abscesses were drained. Following recovery after an extremely stormy course the following observations were noted: (1) calcification of the head and tail of the pancreas (Fig. 10) (2) a large and swollen pancreas as evidenced by an increase in the duodenal curve (Fig. 11) and by anterior displacement of the stomach (Fig. 12) (3) secretin test on two occasions revealed that the secretion of pancreatic juice was diminished over one half and that the concentration of amylase was one third of normal (4) a diabetic type of glucose tolerance curve 5 months after his last severe attack (Fig. 13). Since his discharge he has had several moderate attacks of pain, has felt weak and has failed to gain weight.

This patient demonstrates all the serious complications of acute recurrent pancreatitis. The prognosis is extremely poor. At best it will mean recurrent attacks of pain increasing inability to digest his food and an increasing tendency to develop a more severe grade of diabetes. However he may develop a recurrence of a pancreatic cyst or even a fatal pancreatitis. It would seem that if a reflux mechanism could be proved in this case destruction



Fig. 4



Fig. 5

Figs. 4 and 5. Visualization of the pancreatic duct as a result of increased tone of the sphincter of Oddi. Incidental spasm (Fig. 4) results in passage of injected iodized oil into the main pancreatic duct (on arrow) and thence into the accessory pancreatic duct of Santorini (two arrows). Pain produced by sudden distention of the common bile duct results in reflex spasm of the sphincter of Oddi and allows injected diodrast (35%) to pass up the pancreatic duct, completely outlining it (the tail) (arrow).



Fig. 6



Fig. 7

Figs. 6 and 7. Visualization of the pancreatic duct as a result of spasm of the sphincter of Oddi produced by morphine. Following the administration of $\frac{1}{4}$ grain of morphine, previously the sphincter of Oddi became sufficiently spastic to enable the iodized oil to fill the whole pancreatic duct (arrow). Patient whose gall bladder had been removed weeks previously and the cystic duct drained. On slight rotation of the patient (Fig. 7) the junction of the ducts was clearly visualized.

In different hospitals where various diagnoses such as gastritis, cirrhosis of the liver, duodenal ulcer and delirium tremens were made. This last attack began suddenly 33 hours before admission following a meal

given after a bout of alcoholism and starvation lasting for 5 days. On admission he appeared acutely ill. His temperature was 98 degrees, white blood count 16,400. There was considerable abdominal disten-

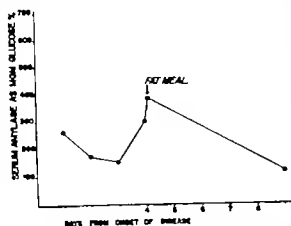


Fig. 8.

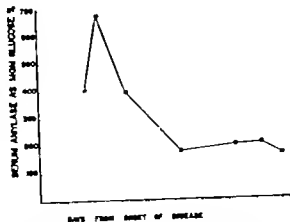


Fig. 9.

Figs. 8 and 9. The serum amylase test as an index of the progress of acute pancreatitis. In Case (Fig. 8) the serum amylase dropped to 61 milligrams per cent on the 4th day but following a fat meal there was a recurrence of symptoms and the serum amylase confirmed the recurrence of acute pancreatitis. In Case 2 (Fig. 9) the serum amylase indicated the gradual recovery from the disease.

tion and marked tenderness on deep palpation in the epigastrium and right upper quadrant. X-ray examination of the abdomen failed to reveal free air under the diaphragm. A serum amylase of 400 milligrams per cent established the diagnosis of acute pancreatitis. Under Miller Abbott tube suction and intravenous hydration and nutrition he improved rapidly, and his serum amylase although it rose on the day of admission gradually subsided (Fig. 9). He developed delirium tremens on the 3rd hospital day and was transferred to the psychiatric division. He improved under appropriate treatment. A cholecystogram showed an apparently normal gall bladder with rather poor concentrating power. X-ray films of the stomach and duodenum failed to reveal any abnormality. He signed out against a release on April 1, 1947.

These 2 patients might conceivably do well on a regimen of frequent small meals and total abstinence from alcohol. However the danger of recurrent attacks, one of which might be lethal, would always be present. An operative procedure which would prevent biliary reflux if such an anatomical condition were present should be considered.

The following case illustrates many of the serious complications of recurrent acute pancreatitis, one of which nearly led to death.

CASE 3. F. J. No. 51642-46, a 34-year-old white male, was admitted to Bellevue Hospital for the first time on October 30, 1946, with a 10-year history of recurrent attacks of severe epigastric and left upper quadrant pain associated with chills and fever. The attacks would last from 1 to 4 days, occur frequently at irregular intervals, although there were periods of 1 to 2 years when he was completely asymptomatic. On 2 occasions the attacks were so severe

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This patient demonstrates all the serious complications of acute recurrent pancreatitis. The prognosis is extremely poor. At best it will mean recurrent attacks of pain, increasing inability to digest his food, and an increasing tendency to develop a more severe grade of diabetes. However, he may develop a recurrence of a pancreatic cyst, or even a fatal pancreatitis. It would seem that if a reflux mechanism could be proved in this case, destruction



Fig. 9.



Fig. 10.



Fig. 11.

Figs. 9, 10, and 11. Result of recurrent attacks of severe acute pancreatitis over a period of 10 years (Case 3). Calcification of the head and tail of the pancreas (Fig. 9).

is clearly shown (arrow). The enlargement of the pancreas is evidenced by increase in the curve of the duodenum (Fig. 10) and by anterior displacement of stomach (Fig. 11).

of his sphincter of Oddi should be considered. However, his condition has progressed so far that a total pancreatectomy may have to be done to cure him.

The next patient illustrates recurrent acute pancreatitis due to obstruction of the papilla of Vater by a stone.

CASE 4. D. C. No. 43136-47, a 37 year old colored woman was admitted for the first time to the 3rd Surgical Division of Bellevue Hospital on September 1, 1946 with a 3 year history of attacks of severe epigastric pain radiating to the back. One month previously she was treated at another hospital for peptic ulcer. The day before admission she devel-

oped a severe attack for which she was admitted to another hospital and then transferred to Bellevue Hospital.

On admission she appeared to be quite ill. Temperature, pulse and white blood cell count were markedly elevated. The abdomen was distended, and tenderness was marked in the epigastrium and right upper quadrant. X-ray films of the abdomen revealed distended small bowel but no fluid levels or free air. A serum amylase taken soon after admission was 256 milligrams per cent. A diagnosis of acute pancreatitis was made, and the patient treated by Miller Abbott tube suction and intravenous hydration. The symptoms subsided rapidly and the serum amylase fell to normal on the fourth day of her illness (Fig. 12). A cholecystogram, done on the ninth day of her illness, failed to visualize the gall bladder. The routine fat meal given with this procedure induced another attack of epigastric pain. Blood amylase taken the next day was 500 milligrams per cent. This high amylase subsided rapidly to normal figures. X-ray examination of the stomach and duodenum was reported normal. A diagnosis of chronic cholecystitis in addition to recurrent acute pancreatitis was made and an exploratory operation was carried out on October 3, 1946. A thin, inflamed cystic duct was dilated and contained 3 stones. The common duct was 2 centimeters in diameter, inflamed and thickened. A number of small stones could be palpated inside it. The head of the pancreas was found somewhat indurated.

After ligating the cystic duct, a needle was introduced into the common duct and lipiodol was injected. A cholangiogram (Fig. 13) revealed the presence of the stones, but the pancreatic duct was not visualized. The gall bladder was removed, and

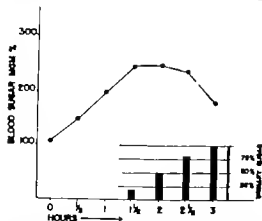


Fig. 3. The progressive destruction of the pancreas by recurrent attacks of pancreatitis in Case 3 involves not only the acinar cells but the islet cells as well, as shown by the diabetic type of glucose tolerance curve.

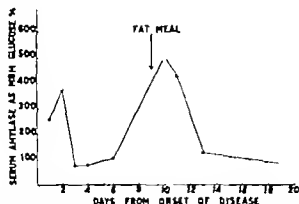


Fig. 14. Serum amylase determinations in Case 4 demonstrate the recovery from an attack of acute pancreatitis and the recurrence of the disease following the administration of a fat meal.

the common duct was opened. After removing the calculi a catheter was inserted into the distal part of the duct for a distance of 2 centimeters and secretin administered intravenously. About 4 cubic centimeters of rather mucoid colorless fluid was obtained from the catheter. This proved to be pancreatic juice since on analysis later on it was found to contain 1,000 milligrams per cent of amylase. The common bile duct was drained by a T tube.

Two weeks later, cholangiographic studies revealed a spastic sphincter (Fig. 16). Following the administration of morphine a long narrow rather fixed intramural portion of the bile duct could be visualized (Fig. 17). This did not change after the administration of amyl nitrate. Several cholangiographic studies showed the same picture. The pan-



Fig. 15. Cholangiogram performed on the operating table in a case of acute pancreatitis due to intermittent obstruction of the papilla of Vater by a small stone. The common duct is seen to contain stones, but the pancreatic duct is not visualized due to absence of sufficient obstruction at this time.

creatic duct could not be visualized by the use of morphine. However closure of the T tube produced no symptoms. The tube was removed 40 days after operation. The fistula closed immediately and she has been symptom free since.

We consider this patient one who has a common biliary-pancreatic passageway (reflux mechanism) as proved by the presence of pancreatic juice in the common bile duct after the administration of secretin. The sphincter of Oddi was not sectioned since it was felt at the time of operation that the reflux of bile into the pancreas was due to obstruction by stone and not by spasm. However since the anatomical



Fig. 6.



Fig. 17

Figs. 6 and 17. Acute pancreatitis due to obstruction of the papilla of Vater by a stone (Case 4). Two weeks after removal of the common duct stones, cholangiographic studies show that the sphincter has a normal tone (Fig. 16). Following the administration of morphine the whole biliary tract is outlined, but the pancreatic duct is not visualized. The intramural portion of the common duct is narrowed by compression of the duodenal wall musculature (arrow).



Fig. 8. Visualization of the pancreatic duct at operation in case of recurrent acute pancreatitis of 20 years duration (Case 5). As a result of spasm of the sphincter of Oddi produced by hydrochloric acid injected through a duodenal tube the iodized oil passed up the pancreatic duct (arrow).

condition (a common passageway) remained intact the prognosis has to be guarded since recurrence remains a possibility.

The next patient presented represents the type of case in which two previous operations on the biliary tract had failed to prevent recurrences of extremely severe attacks of pain.

CASE 5. M. H. No. 10100-47 was a 53 year old woman with a history of a cholecystectomy 20 years previously for attacks of severe epigastric pain. The recurrent attacks persisted and 7 years ago following an attack of severe epigastric pain accompanied by



Fig. 9. The piece of tissue removed by the endobiliary sphincterotomy from the sphincter of Oddi in Case 5 shows connective and muscle tissue, glands of the common bile duct wall, and duodenal mucosa.

jaundice (icteric index 40) an exploratory operation was carried out by an extremely able surgeon. The common bile duct was moderately dilated but contained no stones. A chronic pancreatitis, as evidenced by a hard irregular mass in the head of the pancreas was found. To make certain that no obstruction existed a probe was passed down the choledochus into the duodenum which was opened to confirm the passage of the probe. Common duct drainage was maintained for 2 weeks. Attacks recurred 1 year later and steadily grew worse both in severity and frequency in the last 6 months occurring every 2 weeks. She was admitted to 3rd Surgical Division of Bellevue Hospital on February 11, 1947 3 days after the onset of an attack of severe epigastric and left upper quadrant pain associated with nausea vomiting and fever. Her temperature was 102.4 degrees, pulse 110, white blood count 10,000. The abdomen was distended. X-ray examination revealed no free air beneath the diaphragm but showed distended small bowel with fluid



Fig. 20.



Fig.

Figs. 20 and 8. Cholangiographic studies in Case 5, 1 week after sphincterotomy show the free entrance of iodized oil into the duodenum (Fig. 20). Following application of acid to the duodenum (Fig. 8) the pancreatic duct is not visualized. Under similar conditions prior to sphincterotomy the pancreatic duct was visualized (Fig. 8).

levels. Miller Abbott tube suction and intravenous hydration were instituted. The next day the temperature rose to 105.4 degrees but subsided rapidly under treatment. The serum amylase on the fourth, fifth and sixth days of the attack was 22, 40 and 60 milligrams per cent respectively. Following a fat meal on the sixth day it rose to 72 milligrams per cent. On March 4, 1947 the symptoms recurred for 1 day with a rise of temperature to 102 degrees. The serum amylase was 84 milligrams per cent and the blood sugar 201 milligrams per cent. A secretin test on March 20, 1947 revealed a normal response of pancreatic secretion in regard to volume but a very high concentration of amylase. The serum amylase rose from 84 milligrams per cent at the beginning of the test to 160 milligrams per cent at the end of the test. A glucose tolerance curve was normal. X-ray examination of the stomach and duodenum was reported to be normal. On the basis of the past history and findings and by a process of exclusion it was felt that this patient was suffering from attacks of recurrent acute pancreatitis in spite of the fact that a high serum amylase was not detected during the period of observation. The extremely low amylase figures found after the first attack also suggested the recovery phase of pancreatitis as noted by McCorkle and Goldman.

It was felt that the severity of the patient's symptoms justified section of the sphincter of Oddi if it could be shown that a common passageway existed between the bile and pancreatic ducts. Operation was performed on March 24, 1947. The pancreas was found uniformly enlarged and indurated. The common bile duct was exposed and found moderately dilated. The remnant of the cystic duct about 2 centimeters long left behind at the cholecystectomy performed 20 years previously was opened and



Fig. 22. The administration of morphine in Case 5 two weeks after sphincterotomy shows compression of the intramural portion of the common bile duct due to increased tonus of the duodenal wall. This acts as a one-way valve and prevents duodenal reflux after the sphincter of Oddi is cut.

a catheter tied into it. Lipiodol was injected slowly into the biliary tract simultaneously 5 cubic centimeters of 10% normal hydrochloric acid was injected into the duodenum by means of a duodenal tube passed preoperatively. This was done to produce spasm of the sphincter of Oddi without producing contraction of the duodenal musculature in order to set up the optimum conditions for visualization of the pancreatic duct (15). A cholangiogram obtained under these conditions clearly showed the pancreatic duct and proved the presence of reflux (Fig. 18). Accordingly the sphincterotomy to be described later was passed into the duodenum

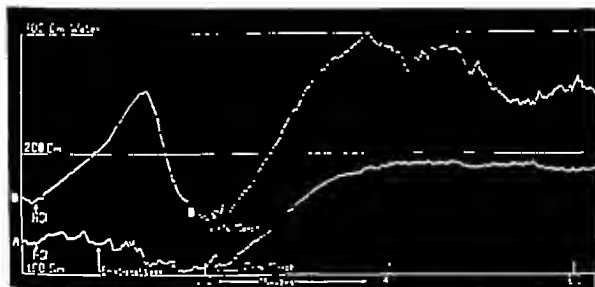


Fig. 23. Kymographic tracing A of the resistance to flow of bile into the duodenum in Case 5 indicates that the sphincter of Oddi is destroyed functionally since there is no response either to local application of acid or to emotional stimuli. The response to morphine is limited to its action on the duodenal musculature. This tracing can be compared to the response of the intact sphincter to acid and morphine (B superimposed).

pancreas implanted into the jejunum should prevent both diabetes and steatorrhea.

Archibald first suggested sphincterotomy for pancreatitis in 1913 (1) and first performed it transduodenally in 1918 on a patient suffering from recurrent attacks of acute pancreatitis. In all he operated on 8 patients. He was able to follow 6 of these patients and found them symptom free without evidence of cholangitis (3). The objections to performing this operation transduodenally were due to the danger of opening of the duodenum, the difficulty of finding the papilla of Vater with out opening the bile duct and passing a probe down into the duodenum and most important of all the difficulty of cutting of the sphincter transduodenally without destroying the musculature of the duodenum through which the common bile ducts courses obliquely. It is this oblique course through the duodenal wall as Coffey had shown in devising his operation for ureterocolic anastomosis which prevents duodenal reflux. Every time the duodenum contracts both the bile and pancreatic ducts are closed off by the valve like action of the duodenal musculature (Figs. 24 and 25). At Archibald's suggestion an effort was made to develop an instrument which would section the sphincter of Oddi safely through an open

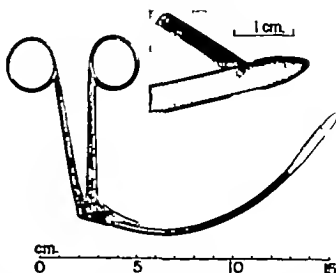


Fig. 26 Endocholechochal sphincterotomy. The length and curvature of the instrument are adapted to insertion into the duodenum through the common duct. Since the handle and knife are in the same side and plane only the anterior free lip of the papilla of Vater can be cut. The length of the effective section is 1 centimeter.

ing in the common bile duct and not through the duodenum and at the same time would not cut the duodenal musculature. Such an instrument was finally perfected by Colp and Doubilet (9) (Figs. 26, 27, 28) and was used successfully in the treatment of dyskinesia of the sphincter of Oddi (4, 5, 7, 8). This instrument was also used by Colp (6) in 1945 in an

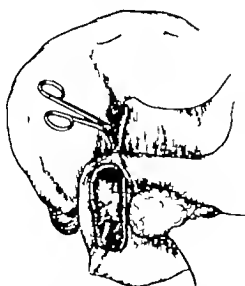


Fig. 27

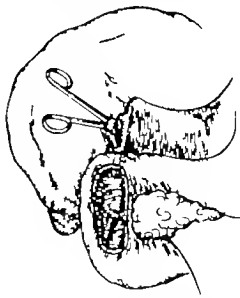


Fig. 28.

Figs. 27 and 28. Endocholechochal sphincterotomy. The instrument is inserted through the common duct into the duodenum until it elevates the anterior duodenal wall (Fig. 27). The blade is then opened to convert the instrument into a book and the instrument withdrawn until it catches the papilla. On closure, the sphincter of Oddi is sectioned in one plane.

attempt to prevent reflux in a patient who developed an acute perforation of the common bile duct as a result of retrojection of the pancreatic juice into the bile duct. Subsequent x ray and kymographic studies failed to show evidence of division of the sphincter.

The curve of the instrument with relation to the anatomy of the bile duct, duodenum and the papilla of Vater is constructed so that it can be used without danger. It will destroy the function of the sphincter of Oddi without interfering with the intramural portion of the common bile duct and so accomplishes the purpose of the operation without danger of a resultant cholangitis.

The cholangiographic and kymographic studies presented here not only corroborate each other but also indicate that the resistance to flow of bile into the duodenum is made up of two components: (1) the sphincter of Oddi and (2) the duodenal musculature. The resistance of the sphincter of Oddi under normal conditions is probably a constant factor. This resistance may be modified by the presence of acid in the duodenum or by the emotional reactions of the individual. On the other hand the resistance produced by the duodenum is equivalent to about 100 to 120 millimeters of water and is increased only during a phase of the passage of a peristaltic wave or by a general increase in intestinal tonus.

Fundamentally the function of the sphincter of Oddi is to increase the resistance to the flow of bile into the duodenum to an extent just sufficient to fill the gall bladder. In animals, destruction of the sphincter leads to complete loss of function of the gall bladder. (9) It ceases to fill and therefore to empty and becomes a collapsed flaccid diverticulum. On physiological principles, the indications are clear that when the sphincter of Oddi is destroyed the gall bladder should be removed. This point should be considered in any future work on the sphincter of Oddi.

The first 2 cases presented are typical of recurrent acute pancreatitis in patients in whom the biliary tract is normal. They pose the problem as to the treatment which would be required to prevent recurrences. The third case represents the serious complications short of death that may ensue as a result of

neglecting to treat these patients with recurrent acute pancreatitis. The fourth case represents the type in which the biliary tract is involved. Merely removing the gall bladder and the common duct stones is not the optimum treatment since the basic anatomical condition, a common passageway between biliary and pancreatic ducts, has not been changed. Case 5 shows definitive treatment of recurrent acute pancreatitis if disease is due to biliary reflux.

CONCLUSIONS

1. Reflux of bile into the pancreatic duct should be prevented by cutting the sphincter of Oddi.
2. Endocholedochal sphincterotomy can be performed with safety without danger of producing cholangitis by duodenal reflux.
3. Endocholedochal sphincterotomy should be the definitive surgical procedure in the treatment of recurrent acute pancreatitis if reflux of bile into the pancreas through a common biliary pancreatic passageway can be demonstrated.

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HYPOSPADIAS WITH ENLARGEMENT OF THE PROSTATIC UTRICLE

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THE prostatic utricle is of interest because it may serve as an indicator of intersexuality in the male. A number of instances of cystic dilatation of the utricle and of greater degrees of persistence of the muellerian ducts are recorded in the literature.¹ The association of enlargement of the utricle with other genital defects such as hypospadias and incomplete testicular descent has long been known (1, 42). It has been suggested that hypospadias in the male is an intersexual manifestation rather than an isolated fusion defect (13, 15). If this theory is correct, congenital enlargement of the utricle might be expected to occur frequently in hypospadias individuals and the degree of differentiation of the muellerian ducts in the female direction should vary in proportion to the severity of the penile deformity. This paper is based upon a study of 14 unselected males undergoing surgical treatment for hypospadias at the University of California Hospital. In 10 of these an abnormal degree of development of the uterovaginal tract has been found. There is also a close correlation between the degree of differentiation of the structures of muellerian derivation and the severity of the penile and other genital anomalies (Table I).

MATERIAL AND METHODS

The cases were selected as follows: (1) they were hospitalized for surgical treatment of congenital hypospadias; (2) testes were demonstrated either by palpation or by laparotomy and biopsy; and (3) permission for cystoscopy was obtainable. The ages of the subjects varied from 1 to 29 years. Minor degrees of hypospadias are not represented since they are not treated surgically. Testicular biopsy was performed only twice. In the

others the gonadal sex was based upon the physical examination.

The urethra was examined endoscopically and the utricle explored with a catheter. When the catheter could be passed for a distance of 2 centimeters or more x-ray films were taken before and after injection of a radio-opaque substance. Twice it was possible to pass the endoscope directly into a vagina. There were no untoward reactions. Table II shows the normal length of the utricle according to various authors. For the purposes of this study the dividing line between normal and abnormal size of the utricle was chosen as the base of the prostate for the child and at a distance of 2 centimeters from the utricular orifice for the adolescent and adult. In only one instance (Case 4) was a measurement close to the dividing line obtained.

ABSTRACTS OF CASES

CASE 1. C.F. This boy was examined July 13, 1945 at the age of 11 years. There were no siblings. The penis was of normal size with a false meatus in the glans. The urethral meatus was 2 millimeters proximal to the coronal sulcus and moderate chordee was present. The scrotum, scrotal contents, and prostate were normal. Cystourethroscopy gave normal findings. The utricle admitted a catheter for 5 millimeters.

CASE 2. M.O. This man was examined August 28, 1944 at the age of 29 years. He had one normal brother. The penis was of normal size with the meatus midway between the penoscrotal junction and the coronal sulcus. Moderate chordee was present. The scrotum, scrotal contents and prostate were normal. Endoscopic examination of the bladder and posterior urethra gave normal findings. The utricle admitted a catheter for 5 millimeters. The ejaculatory ducts were easily identified.

CASE 3. H.D. This patient was examined December 12, 1943 at the age of 17 years. He had one normal brother and one normal sister. Hypospadias and imperforate anus were present at birth. Following proctoplasty at the age of 3 days he developed a fistula between the bulbous urethra and the perianal scar. This fistula later was closed surgically. The penis was of normal size with the urethral meatus midway between the penoscrotal junction and

From the Division of Surgery, Subdivision of Urology, University of California Medical School, San Francisco.

¹Articles marked with asterisk (*) references tend of article

TABLE I

Group	Case	Age	Testicles	Degree of hypospadias	Urethral duct development	Other anomalies
I	1	20	Normal	Penile	Normal stricture	None
			Normal	Penile	Normal stricture	None
			Normal	Penile	Normal stricture	Impotency seen
			Left, normal; right normal	Penile	Normal stricture—on long	None
			Normal	Penoscrotal	F. large stricture	Unilateral hernia
			Normal	Penoscrotal	Enlarged stricture	None
II	2	7	Normal	Penoscrotal	Enlarged stricture	None
			Small left fully descended, right in upper scrotum	Penoscrotal	Enlarged stricture	None
			Left, normal; right normal	Penoscrotal	Enlarged stricture	None
			Both inguinal	Penoscrotal	Enlarged stricture	Premature birth
			Both inguinal	Penile	Enlarged stricture	Premature birth
			Small left fully descended right, normal	Penile	Enlarged stricture	Cyclostroma
III	3	20	Left absent right, inguinal	Penile	Urethra—absent tubes, vagina entering posterior urethra	Seminal vesicles absent vas deferens
			Atrophic and pelvic	Perineal	Urethra—absent tubes, vagina entering anterior urethra	Prostate, seminal vesicles, and vas absent

the coronal sulcus. Moderate chordee was present. The scrotum, scrotal contents and prostate were normal. The bladder and posterior urethra were normal endoscopically. The utricle admitted a catheter for 1 centimeter. The ejaculatory ducts were identified.

CASE 4. W. R. This man was examined June 9, 1945 at the age of 33 years. He had one normal brother. The penis was at the lower limits of normal size. The meatus was midway between the penoscrotal junction and the coronal sulcus and moderate chordee was present. The right testicle was normal and fully descended. An atrophic left testicle was palpable outside the external inguinal ring. The prostate was normal. The bladder and posterior urethra were normal endoscopically. The utricle admitted a catheter for 3 centimeters but could not be distended by injection. The ejaculatory ducts were identified.

CASE 5. R. E. This child was examined January 7, 1944 at the age of 2 years. He had one normal

sister. A congenital umbilical hernia was present. The penis was of normal size with the urethral meatus at the penoscrotal junction and moderate chordee. The scrotum, scrotal contents, and prostate were normal. Cystourethroscopy showed a large utricular orifice in the normal position. Dimensions of the utricle as measured on the x-ray films were 2.0 by 0.6 by 0.6 centimeters.

CASE 6. G. C. (Fig. 1) This child was examined April 9, 1945 at the age of 3½ years. He had one normal sister. The penis was normal in size but with the meatus at the penoscrotal junction and moderate chordee. The scrotum, scrotal contents, and prostate were normal. Urethroscopy showed a large utricular orifice surrounded by hymen-like flaps standing in a slight elevation representing the verumontanum. The right ejaculatory duct was identified. X-ray visualization showed a large utricle with several diverticula. The dimensions of the utricle were 4.5 by 3.0 by 3.0 centimeters.

CASE 7. G. A. This boy was examined September 13, 1945 at the age of 14 years. He had one normal brother and one normal sister. The penis was normal in size but with the urethral meatus in the anterior portion of a partially cleft scrotum. Marked chordee was present. The testicles were normal and fully descended. The prostate was normal. Urethroscopy showed a mushroom-shaped verumontanum with a large utricular orifice. The ejaculatory ducts were not identified. The utricle measured 5.0 by 1.6 by 1.5 centimeters.

CASE 8. E. R. (Fig. 2) This young man was examined August 28, 1944 at the age of 21 years. There were no siblings. The penis was slightly smaller than normal. The meatus was in the anterior portion of a partially cleft scrotum. Marked chordee

TABLE II

Reference	Number of specimens studied	Length of normal stricture	Number of cases of enlargement of the stricture
McCarthy et al. (1927)	90 adults	8 mm.	
McMahon (1938)	adults	4-10 mm.	
R. A. Moore (1941)	678 adults	mm.	2
Springer (1951)	infants	5-11 mm. from base of urethra to base of the prostate	

was present. The testicles were slightly smaller and softer than normal. The left testicle was fully descended but the right was in the upper scrotum. The prostate was normal. Urethroscopy showed replacement of the verumontanum by frond like flaps of mucous membrane overlying the utricular orifice. The utricle measured 6.4 by 2.8 by 3.0 centimeters.

CASE 9. C I. This boy was examined December 13, 1943 at the age of 8 years. There were no siblings. The penis was slightly smaller than normal with the meatus at the penoscrotal juncture and marked chordee. The scrotum was partially cleft. The right testicle was normal and fully descended. The left testicle lay just outside the external ring at this time but descended spontaneously 3 years later. The prostate was normal. The dimensions of the utricle were 3.3 by 1.6 by 1.4 centimeters.

CASE 10. D U. This boy was examined May 11, 1945 at the age of 6 years. He was born after 7½ months gestation. There were no siblings. The penis was slightly smaller than normal with the meatus at the penoscrotal juncture and marked chordee. The testicles were felt just outside the external inguinal rings, but could be brought easily into the partially cleft scrotum. The prostate was normal. The utricle measured 2.4 by 0.7 by 0.8 centimeters.

CASE 11. J P. (Fig 3). This patient was examined November 11, 1943 at the age of 14 months. There were no siblings. He was born weighing 1200 grams after 7 months gestation. Growth and development were slow and the bone-age was retarded. The penis was small with the urethral meatus in midscrotum. Marked chordee was present. The scrotum was bifid. The right testicle was palpable at the external ring. The left testicle was not palpable at this time



Fig 1. Case 6. Dilated utricle with diverticula occurring in association with penoscrotal hypospadias.

but became palpable at the external ring at the age of 2½ years. A prostate was palpable and the prostatic urethra was normal endoscopically. The utricle measured 2.5 by 1.0 by 0.9 centimeters.

CASE 12. W S. This college student was examined September 5, 1944 at the age of 22 years. He had 3 normal brothers and 1 normal sister. His mother a brother was said to have a feminine appearance but details were not available. The body con-



Fig 2. Case 8. A large utricle filled by retrograde injection is shown in anteroposterior and oblique projections. This patient also has penoscrotal hypospadias and an incompletely descended right testicle.

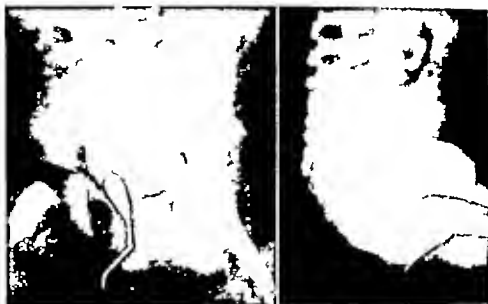


Fig. 3. Case 12. These anteroposterior and lateral views show dilated uterine cavity after injection. Perineal hypospadias and bilateral inguinal cryptorchidism are also present.



Fig. 4. Case 13. A catheter passed into the urethra; contrast has traversed the urethra and entered the cervix. In the injection of radio-opaque salt has filled the urethra and the uterus. The contrast substance has entered the vagina through the right uterine cornu, visualized the epididymis,

four was somewhat feminine. The facial hair was downy. The escutcheon was feminine but the penis was not developed. His voice was high pitched. Large breasts with little glandular tissue had begun their development at the age of 12 years. Erections were infrequent and there had never been any discharge of semen. He was psychometrically masculine. The penis was 5 centimeters long. The urethra opened behind a labial scrotum and marked chordee was present. The left testicle, a full 6 centimeters, descended but pubescent in size while the still smaller right testicle was palpable at the external ring. 17 chromosomes were clearly identified. The prostate was 15 to 35 normal size. Urinary 17-ketosteroid estimation gave normal male values. Urinary gonadotropin estimation gave constant values of from 15 to 25 mouse units, a figure well within the range for normal men. The urethra was endoscopically masculine with visible secretion expressible from the prostatic ducts. Ejaculatory ducts were not identified. The uterine measured 2.0 by 2.5 by 1.5 centimeters.

CASE 13. W.I. (Fig. 4). This boy, examined November 5, 1943, at the age of 3 years, had two normal sisters and 2 normal brothers. He appeared small with marked chordee. The urethral meatus was in the perineum. The scrotum, a cleft and also deficient on the left. The right testicle was palpable at the external ring and its identity was proven

by palpation, and extravasated into the tunica vaginalis. The arrow lies over the inguinal testicle. The lower limit of the bladder is outlined by the contrast material. There is no evidence of contrast material entering the bladder region.

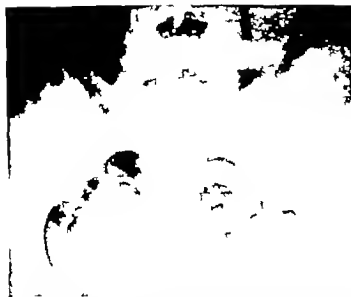


Fig. 5. Case 14. Injection through the vaginal orifice in the urogenital sinus has visualized the vagina, uterus, and



uterine tubes. This patient possesses small pelvic testes. There are no ovaries.

by biopsy. The left gonad was absent but a poorly developed left epididymis was found in the pelvis. An infantile bipartite uterus in communication with a vagina entering the posterior urethra just proximal to the external sphincter was demonstrated by x ray examination and by laparotomy. The right vas deferens communicated with the uterus. The left vas was incomplete and blind. Uterine tubes and seminal vesicles were not identified. The posterior urethra felt slightly thickened on rectourethral palpation but a prostate was not certainly identifiable. Laparotomy was performed on this patient for determination of the nature of the left gonad. The vagina, first demonstrable only by x ray examination, was examined directly with the cystoscope 3 years later finding a single external os. Following a urethroplasty and perineal urethrotomy with catheter drainage in 1946 the patient developed a febrile infection caused by accumulation of infected urine and pus in the vagina. This infection was successfully treated by endoscopic lavage.

CASE 14. M.H. (Fig. 5) This young man was examined May 16, 1945 at the age of 20 years. He had 3 normal brothers and 2 normal sisters. He had been brought up as a girl but the bodily contour, breasts and voice were masculine. His facial hair required shaving thrice weekly. He had never menstruated. Psychometric tests gave strongly masculine findings. The penis was markedly incurvated and measured 7 centimeters. Laparotomy disclosed atrophic pelvic testes and epididymides. The nature of the gonads was proved by biopsy. No vasa seminal vesicles or prostate could be found. A small uterus and uterine tubes were present. The vagina entered the urethra distal to the external sphincter forming a short persistent urogenital sinus opening in the perineum. The scrotum was undeveloped and resembled labia majora. No urethral glands or verumontanum were demonstrable endoscopically.

Determination of the 24 hour urinary 17 ketosteroid excretion gave values of 13.6 for the total and 8.8 for the ketonic fraction, figures which are borderline between the average findings for males or females.

Exploratory laparotomy was performed for determination of gonadal sex. Later the patient's legal sex was changed to male and plastic procedures on the penis were performed.

DISCUSSION OF FINDINGS

Anatomically these 14 individuals may be divided into three groups. In group I (Fig. 6) penile hypospadias is the only departure from normal. In group II (Fig. 7) penoscrotal or perineal hypospadias is present with increasing degrees of chordee and diminution of the size of the penis. Anomalies of testicular descent and size are frequent and the prostate may be poorly developed. The normal prostatic utricle is replaced by a rudimentary vagina entering the urethra at the verumontanum which is frequently abnormal and sometimes occupies a position caudal to the normal. A uterus and uterine tubes are not demonstrable. The dilated utricle is normally empty and its thin walls are not noticeable on palpation of the prostate. On urethroscopy the utricular orifice is larger than normal and sometimes surrounded by hymen-like flaps. On catheterization of the orifice and distention of the utricle with fluid a soft pyriform or ovoid mass lying usually a little to the right or left of the midline is easily

felt extending upward from the midportion of the prostate between the genitourinary tract and the rectum (Figs 1 2 3) After withdrawing the catheter the organ readily empties itself spontaneously In group III (Fig 8) the external genitalia closely resemble those of the female. The testicles are incompletely descended The prostate seminal vesicles, and vasa deferentia are poorly developed or absent and a rudimentary uterus is present with the vagina communicating with the posterior urethra or uniting with the urethra distal to the external urinary sphincter to form a persistent urogenital sinus. The uterovaginal tract may be demonstrated by x ray examination (Figs. 4 5) or by direct endoscopy

Except in Case 13 where the vagina became temporarily infected during a period of urethral catheter drainage the 10 patients in this series possessing abnormal muellerian remnants have shown no signs of urinary tract obstruction or infection nor have they complained of pain or other symptoms attributable to these anomalies In no case has surgical removal of the vagina or uterus been considered necessary

These young men and boys appear masculine in behavior and temperament and generally in physique although evidences of mild to moderate hypogonadism are present in Cases 8 11 12 and 14 Of possible etiological significance in a negative sense is the absence of a family history of urogenital anomalies and the relationship of 13 normal brothers and 9 normal sisters to the group as a whole. Extraurogenital anomalies are infrequent.

DISCUSSION OF THE SIGNIFICANCE OF DILATATION OF THE UTRICLE

The association of any other genital anomalies with dilatation of the prostatic utricle is by no means uniform nor is the condition always congenital Several possible causes are to be considered (1) inflammation (2) neoplasia (3) local developmental errors and (4) intersexual development of the embryo

Springer in 600 male autopsies found 3 utricular cysts in adults and one in a child These cysts did not communicate with the urethra Because of the finding of associated inflammation of verumontanum and prostate

he concluded that the cystic dilatation was secondary to inflammatory closure of the utricular orifice Michailow by endoscopy and von Gaza by surgical exposure observed and treated utricular cysts which they felt on clinical grounds were inflammatory R. A. Moore (32) in 678 autopsy specimens found instances of cystic dilatation of the utricle but was unable to determine whether they were congenital or the result of inflammation.

At least 5 cases of massive retrovesical cysts apparently resulting from a benign adenomatous process in the utricle or a nearby muellerian duct rest have been reported (2 8 11 18 36)

Several possible local deviations from normal development are capable of causing utricular enlargement. Englich, on the basis of autopsy studies, suggested that cystic dilatation of the utricle may arise from valve formation or fusion of the fetal mucosa membrane at the point where the muellerian ducts enter the urogenital sinus. Boshamer in a clinical study of 4 adults with utricular cysts within the verumontanum not communicating with the urethra concluded that these cysts arose from a purely local developmental error because of the absence of signs of inflammation and of associated congenital defects In certain mammals particularly in ruminants the utricle is normally a small cyst distinct from the urethra (22 38) Siddiqui has shown in the ground squirrel that the growing muellerian ducts of the male embryo never reach the urogenital sinus. In the adult male of this species the prostatic utricle is either absent or present as a small rounded structure which does not communicate with the urethra. Whether this is the mechanism of development of the normal closed utricle of cattle is not known nor is there proof that analogous incomplete growth of the caudal ends of the muellerian ducts occurs in the human. However an atavistic change of this nature provides a ready explanation for isolated congenital cysts of the utricle Squamous metaplasia of the epithelium of the prostatic urethra and utricle in response to maternal estrogen during the latter months of pregnancy has been shown to occur in the human male fetus. When this epithelium desqua-

mates it frequently chokes the cavity of the utricle causing dilatation (5)

Although inflammation neoplasia isolated developmental errors and physiologic epithelial metaplasia account for many instances of enlargement of the utricle the findings in the subjects of this study are best explained on the basis of a feminization of the male embryo. Male pseudohermaphroditism as seen in Case 14 presents a striking example of feminization. The less obvious utricular enlargement with penoscrotal hypospadias becomes significant as an intersexual phenomenon when its relationship to the associated genital anomalies is considered from the embryologic standpoint.

A corollary to the theory of an intersexual type of development for this kind of utricular anomaly is that hypospadias also has a similar etiology. This view was supported by Felix but Young (46) felt that except in the pseudovaginal type of hypospadias the defect could be explained simply as the result of arrested development. The present study, although based upon a small number of cases has uniformly demonstrated utricular enlargement in penoscrotal and perineal hypospadias. The only difficulty in explaining penile hypospadias on the basis of a simple developmental error is the lack of a satisfactory explanation for the chordee. If feminization of the embryo is assumed to occur this difficulty is overcome, and penile hypospadias may be considered as a minimal degree of intersexual development.

Although Crew was able to correlate the changes in the external genitalia gonads and gonaducts of intersexual goats and pigs according to the degree of deviation from the normal, studies in the human have been lacking. Few cases of enlargement of the utricle in association with hypospadias are reported in the literature (1, 27, 30, 45). This is not surprising since the persistent muellerian structures rarely cause symptoms and routine endoscopic examination is not generally practiced in hypospadias. Actually reference to the presence of a definitive uterus in males with perineal hypospadias is encountered more frequently because the severity of the external deformity leads to surgical exploration (6, 9, 33, 45).

The freemartin of cattle and the congenital adrenogenital syndrome in the human suggest that masculinization of the female fetus by hormonal action sometimes occurs. Whether feminization of a gonadal male fetus takes place on a genetic or an endocrine basis is debatable and cannot be settled here (see Witschi, C. R. Moore and Greene, 15). However, treatment of pregnant rats with estrogen has shown that in this particular form of feminization of the male embryo the changes produced are hypospadias high testes stimulation of the female ducts and inhibition of the male ducts and prostatic changes similar to those observed in the human (16). While there are instances of a well differentiated uterovaginal tract in association with a normal penis and undescended testicles (34, 42) and also instances of large undifferentiated muellerian remnants in men with normal external genitalia (19, 20, 25) a combination of anomalies of both the internal and external genitalia is far more frequently observed.

In the human embryo of 6 weeks, the primordia of the genitalia are present in an asexual form consisting of abdominal gonads the genital tubercle the wolffian ducts and the developing muellerian ducts. In the male embryo of 8 weeks, the gonad is distinguishable as a testis and the wolffian and muellerian ducts have established communication with the urogenital sinus at Mueller's hillock which remains in the adult as the verumontanum. The wolffian system develops rapidly. The mesonephric tubules unite with the tubules of the testis and the mesonephric duct forms primitive seminal vesicles at 10 weeks. During the period between 8 and 10 weeks the muellerian ducts undergo a brief period of incomplete proliferation without ever forming a definitive uterus or oviducts and begin to degenerate at 10 weeks. This degenerative process rapidly goes to completion leaving a remnant of the cranial end of each duct as the appendix testis and a remnant of the fused caudal ends as the prostatic utricle.¹ During

¹Vilas has presented excellent evidence that the epithelium of the human prostatic utricle is all derived from the urogenital sinus contrary to the more generally accepted view that the organ is entirely of muellerian duct origin. In either case, the utricle, at its inception, arises from the growth of the muellerian ducts into the urogenital sinus.

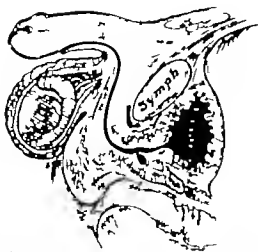


Fig. 6. Group I. Penile hypospadias is the only abnormality present. The testicle, prostate, seminal vesicle and urethra are normal. This constitutes minimal degree of feminization.

the period of from 6 to 10 weeks, the primitive phallus of the male enlarges and the urogenital sinus by a process of folding and fusion of the urethral groove from behind for wards, begins the formation of the urethra which is not complete until the 14th week. During the same period the development of the scrotal swellings the gubernaculum and the formation of the processus vaginalis pre-

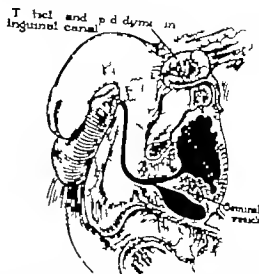


Fig. 7. Group II. There is a penoscrotal hypospadias. The testicle is incompletely descended. The penis, prostate, and seminal vesicle are smaller than normal. The urethra is enlarged. Here, feminization is more marked.

pare the field for the descent of the testis. These changes proceed in a co-ordinated manner as the effect of a masculinizing influence upon the undifferentiated primordia. The same primordia under a feminizing influence in the normal gonadal female go through comparable changes in the opposite direction to form the homologous sexual organs. Whether these sex-determining influences are genetic or endocrine in nature is as yet undetermined (15, 31). In the male embryo should a feminizing influence or its equivalent, a deficiency of masculinizing influence occur during the critical period of development it would bring about associated intersexual changes. The extent of these changes is dependent upon the strength and duration of the feminizing influence and the time of the onset of its action. The penis and urethra, going through a longer period of definitive development are most easily disturbed. Factors preparing the way for testicular descent appear to be somewhat less sensitive. The gonads undergo rapid definitive development in an earlier and shorter period. They are altered only by a more profound influence which if sufficiently strong may bring about extreme inhibition of the wolffian ducts and normal female differentiation of the muellerian ducts. Crew interpreting the anatomical gradation of intersexual

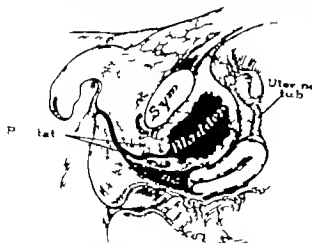


Fig. 8. Group III. The penis resembles a large clitoris. The urethral meatus is perineal. An atrophic testis with a rudimentary epididymis lies in contact with the uterine tube in the pelvis. A well developed uterus and vagina are present. The prostate is underdeveloped and seminal vesicles and vasa are absent. Feminization is extreme.

ity in the plg suggested that a minimal masculinizing stimulus is necessary for normal sexual differentiation. Slight deficiency in this influence in time or degree brings about minor abnormalities affecting the external genitalia only greater deficiency produces more marked alteration of the external genitalia plus incomplete müllerian duct recession still greater deficiency causes pseudohermaphroditic abnormalities of the external genitalia differentiation of the uterovaginal tract and incomplete wolffian duct development. Similar gradations of feminization have been produced experimentally in newborn rats by estrogen treatment of the mother during pregnancy (16). The human subjects of the present study (Table I) also may be classified into similar groups group I penile hypospadias group II penoscrotal or perineal hypospadias anomalies of testicular descent dilatation of the prostatic utricle group III the same as group II plus differentiation of the uterovaginal tract absence of the seminal vesicles and incomplete development of the vasa deferentia (Figs. 6 7 8).

CLINICAL SIGNIFICANCE OF DILATATION OF THE PROSTATIC UTRICLE

Individuals with abnormally large utricles in free communication with the urethra rarely exhibit signs or symptoms of disease on this basis. These organs normally remain collapsed and when filled artificially with fluid rapidly empty themselves. Occasionally they may become distended and infected spontaneously or cause obstruction (7 27). In the course of the operative treatment for hypospadias serious infection may occur (Middleton Case 13 of this series). Endoscopy and radiographic exploration of the utricle is of little value in the diagnosis of sex. The demonstration of a vagina or a uterus is not proof of gonadal femaleness. Should a well developed uterus be demonstrated ovaries are most likely present but if only a large utricle without evidence of uterus is present or if vasa deferentia are visualized the gonads are probably testes. The site of vaginourethral communication is also a differential point determinable by endoscopy. Entrance of the vagina into the posterior urethra is a less femi-

nine characteristic than communication between the vagina and urethra distal to the external urinary sphincter (21, 33). While endoscopic and radiographic findings may add to other clinical and laboratory evidence and aid in forming an opinion of the gonadal sex they are not in themselves conclusive.

The discovery of utricular enlargement in hypospadias and the implication that these anomalies represent an intersexual type of development indicate the advisability of studying these individuals clinically as a whole organism rather than as the victims of an isolated fusion defect.

SUMMARY AND CONCLUSIONS

1. An unselected group of 14 males with hypospadias has been studied endoscopically and radiographically for remnants of the caudal ends of the müllerian ducts.
2. In penile hypospadias the utricle is normal. In penoscrotal and perineal hypospadias, the utricle is markedly enlarged and may communicate with a well developed uterus.
3. The findings are presented as evidence for an intersexual type of development rather than a purely local developmental error as the cause of these anomalies.
4. Other causes of utricular dilatation or enlargement are discussed.

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Reports of cystic dilatation of utericle and persistence of mesonephros ducts

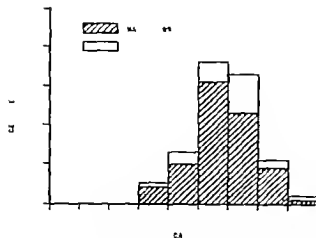


Chart Distribution of cases according to age group and sex.

DIAGNOSIS

The symptoms of pharyngeal diverticulum listed in Table II varied in duration from a few weeks to 40 years the average being 4½ years. Of these only 1 namely noisy deglutition deserves special mention since it is seldom encountered as a symptom of other lesions producing dysphagia. It occurs when the sac contains fluid and air during swallowing. During this act a gurgling sensation is usually palpable at the site of the sac. Pressure on the neck over the sac will sometimes express its contents into the patient's mouth. In other cases physical signs may be altogether lacking.

While the clinical picture of pharyngeal diverticulum is as a rule typical errors in diagnosis do occur. Occasionally we have

TABLE I — PATHOLOGIC DATA

Location (in Esophagoscopist report)	Percent
Left	24
Right	6
Middle	60
Size of sac (Pathologist report)	
Small (up to 1 cm)	3
Middle (1.5 to 5 cm)	43
Large (over 5 cm)	7
Inflammation (Esophagoscopist report)	
Mild	6
Severe	6
Absent or not mentioned	3

TABLE II. — SYMPTOMS

Condition	Per cent	Less common	Per cent
Dysphagia	86	Esophageal food masses	
Regurgitation	43	Fullness in throat	
Noisy deglutition	42	Choking sensation	
Weight loss	4	Soreness in neck	
Cough	5	Hemoptysis	

had to differentiate between pharyngeal diverticulum cicatricial stenosis and carcinoma of the cervical esophagus. Although this was accomplished by the roentgenograms alone in the majority of cases, it was often found necessary to have the esophagograms make the final conclusive study. Therefore in all lesions of the pharynx and esophagus we recommend both roentgenologic and esophagoscopy studies.

TREATMENT

Preoperative In this series, the average length of time required to prepare patients for the operation was 5 days. During this period therapy is directed toward correction of nutritional deficiencies such as secondary anemia, hypoproteinemia and avitaminosis by diet and parenteral methods. In a few instances tube feeding was necessary and in 9 cases preliminary gastrostomy. The latter has been per-

TABLE III. — CONCOMITANT DISEASES AND COMPLICATIONS IN LAST 100 CASES

Preoperative	Number or percent	Postoperative	Number or percent
Cardiovascular (Atherosclerosis, heart block, hypertension)	7	Temporary vocal cord paralysis	
Pulmonary (Tuberculosis, chronic, asthma)	6	Wound infection (suppuration)	3
Urinary retention	3	With fistula	
Tracheo-esophageal diverticula		Recurrence	
Macrobacteremia (Left vocal cord paralysis, dysphagia, septicemia, thyroid abscess and diverticulum, papilloma of larynx, diabetes, severe lesions requiring gastrostomy)	6	Paralysis With recovery 3 to 4 weeks death	4
		Atherosclerosis	
		Pneumonia and death	
		Aortic aneurysm	
		Coronary atherosclerosis and death	

formed only once in the last 137 cases. Concomitant diseases (Table III) require special attention and often prolong the preoperative period.

In order to decrease inflammatory reaction in the sac wall patients are taught to cleanse and empty the sac after each meal by swallowing water compressing the neck at the area of the sac and leaning forward to let it drain out.

Operative. The salient features of the combined one stage procedure are as follows: first cleansing and emptying of the sac through the esophagoscope; second maintenance of the normal anatomic position of pharynx and upper esophagus by keeping the esophagoscope in the esophagus during ligation of the sac neck and translocation of its stump as well as during the entire period of pharyngeal repair. The restoration of normal anatomic alignment, which is assured by this method, favors normal function after healing has occurred. For this operation we have found open drop ether anesthesia to be the most satisfactory.

a. Esophagoscopy technique. It is important to empty the contents of the pouch since it is common to find secretion and often infrequently masses of food. These should be re-



Fig. 1. Roentgenogram of unusually large pulsion pharyngeal diverticulum, showing fundus of sac extending well into the superior mediastinum.

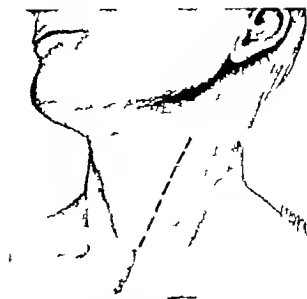


Fig. 2. Skin incision for pharyngeal diverticulectomy.

moved to prevent overflow into the trachea when the pouch is manipulated.

Identification of the diverticulum by the surgeon can be accomplished promptly if the tip of the esophagoscope is introduced into the pouch so that it can be palpated through the incision and the sac transilluminated. After it is clearly identified and partially separated further esophagoscopic assistance is unnecessary until ligation of the neck of the pouch. The esophagoscope is then introduced into the subdiverticular esophagus guided by an olive-tipped bougie passed over a thread swallowed the day prior to operation. This avoids the occurrence of esophageal stenosis which might ensue if too much of the pharyngeal and upper esophageal walls are removed. In addition it also aids the surgeon in removal of the entire pouch.

At the conclusion of operation a feeding tube is inserted through the esophagoscope into the lower esophagus. The esophagoscope is then removed without disturbing the feeding tube the proximal end of which is withdrawn through the nose.

b. Surgical technique. An incision is made along the anterior border of the left sternocleidomastoid muscle from 1 inch above the sternum to the level of the hyoid bone (Fig. 2) passing through the skin, platysma and deep fascia exposing the anterior belly of the omohyoid muscle. The latter may be severed or

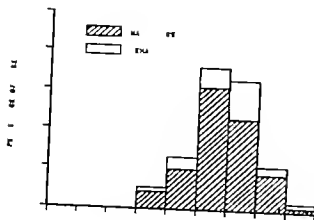


Chart and text Distribution of cases according to age group

DIAGNOSIS

The symptoms of pharyngeal diverticulum listed in Table II varied in duration from a few weeks to 40 years the average being 4½ years. Of these only 1 namely noisy deglutition deserves special mention since it is seldom encountered as a symptom of other lesions producing dysphagia. It occurs when the sac contains fluid and air during swallowing. During this act a gurgling sensation is usually palpable at the site of the sac. Pressure on the neck over the sac will sometimes express its contents into the patient's mouth. In other cases physical signs may be altogether lacking.

While the clinical picture of pharyngeal diverticulum is as a rule typical, errors in diagnosis do occur. Occasionally we have

TABLE I.—PATHOLOGIC DATA

Location of sac (Esophagoscopist's report)	Per cent
Left	24
Right	6
Middle	60
Size of sac (Pathologist's report)	
Small (up to 1 cm)	30
Medium (1 to 5 cm)	43
Large (over 5 cm)	7
Inflammation (Esophagoscopist's report)	
Mild	6
Severe	6
Absent or not mentioned	3

TABLE II.—SYMPTOMS

Common	Per cent	Less common	Very rare
Dysphagia	84	E. pector. loss of mucus	
Regurgitation	83	Fullness in throat	
Noisy deglutition	41	Choking sensation	
Weight loss	44	Swallowing in neck	
Cough	1	Hiccups	

had to differentiate between pharyngeal diverticulum, cicatricial stenosis, and carcinoma of the cervical esophagus. Although this was accomplished by the roentgenologic alone in the majority of cases, it was often found necessary to have the esophagoscopist make the final conclusive study. Therefore in all lesions of the pharynx and esophagus we recommend both roentgenologic and esophagoscopic studies.

TREATMENT

Preoperative. In this series the average length of time required to prepare patients for the operation was 5 days. During this period therapy is directed toward correction of nutritional deficiencies such as secondary anemia, hypoproteinemia, and avitaminosis by diet and parenteral methods. In a few instances tube feeding was necessary and in 9 cases preliminary gastrostomy. The latter has been per-

TABLE III.—CONCOMITANT DISEASES AND COMPLICATIONS IN LAST 100 CASES

Preoperative	No. of cases or per cent	Postoperative	No. of cases or per cent
Cardiovascular: (Aneurysm, fibrillation, heart block, hypertension)	7	Temporary vocal cord paralysis	
Pulmonary (Tuberculosis, chronic, infection)	6	Wound/infection Simple With fistula	1
Urinary retention	3	Recurrent	
Traction esophageal diverticula	3	Pneumonia With recovery With fatal and death	
Mitochondriosis (Left vocal cord palsy, diaphragmatic hernia, duodenal ulcer and diverticulum, papilloma of larynx, diabetes, severe mass lesion requiring gastrostomy)	6	Abscesses	
		Prognosis and death	
		Aneurysm fibrillation	
		Cerebral infection and death	

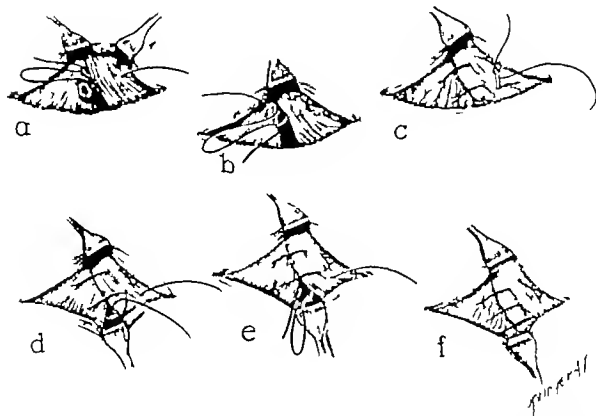


Fig. 4. Steps in repair of pharyngeal wall following excision of diverticulum. a, transplantation of stump beneath inferior constrictor muscle. b, approximation of cricopharyngeus to inferior constrictor muscle. c, d, and e, anchoring of posterior suture to prevertebral fascia. f, pharyngeal repair completed.

of the transfusion suture are used and the stump is transplanted upward beneath the inferior constrictor muscle (Fig. 4a). The muscular defect in the pharyngeal wall is now corrected by approximating the upper margin of the cricopharyngeus to the lower margin of the inferior constrictor with interrupted No. 1 chromic sutures spaced about 1 centimeter apart (Fig. 4b and c). The posterior portion of the suture line which overlies the retropharyngeal space is anchored to the prevertebral fascia (Fig. 4d, e and f). This important stitch obliterates the retropharyngeal space at this point, erects a barrier against descending infection into the mediastinum by way of the retropharyngeal space, and reinforces the posterior portion of the suture line. The incision is closed in layers around a small Penrose drain placed in the lower pole of the wound. The average operating time for this procedure was 45 minutes.

Postoperative. The usual hospital stay after operation is 21 days, but only during the first 5 to 7 days is the patient confined to bed. The

wound is treated as in any clean case and the Penrose drain is removed on the seventh day. A concentrated liquid diet is administered through the indwelling nasal tube in increasing amounts according to the plan in Table IV. In order to maintain nutritional and fluid

TABLE IV — POSTOPERATIVE FEEDING
SCHEDULE FOR AVERAGE CASE

Day	Nasal tube feedings		Time interval between feedings hours
	Water ounces	Concentrated liquids ounces	
	½		
3		1	
4		4	
5		5	4
6-7		6	
8-9	Full Bristol diet		
20	Soft Diet		
After 6 weeks any type of food is allowed			

*The composition is the same as for gastrostomy feedings.

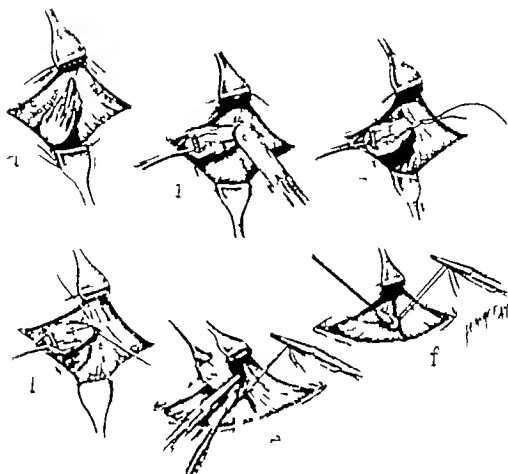


Fig. 3. Steps in excision of pharyngeal diverticulum. a, Initial location of sac in esophagoscope transillumination. b, freeing of sac neck to submucous coat. c, division of sac neck. d, ligation completed. e, severance of sac neck between ligature and clamp. f, sterilization of stump.

retracted. The diverticulum is then approached by incising the pretracheal fascia near its lateral margin, retracting the contents of the carotid sheath laterally and the thyroid gland and trachea medially. It is sometimes necessary to divide the inferior thyroid vessels for better exposure.

The fundus of the sac, which is now rotated into the wound and transilluminated by the esophagoscopist (Fig. 3a) is grasped with intestinal forceps and drawn upward and outward after which the esophagoscope is withdrawn from the sac. The diverticulum is then entirely freed to its junction point with the pharynx (Fig. 3b). Care must be exercised to free all muscle fibers from its neck, exposing the submucous coat. This will assure stability of the ligature to be placed subsequently by minimizing the amount of tissue included in it.

The neck of even the largest diverticulum is seldom more than $1\frac{1}{2}$ centimeters in diameter. A neck larger than this usually indicates a complete dissection.

A moist sponge is packed in the lower pole of the wound to safeguard the mediastinum from contamination. Then with the esophagoscope in the esophagus a transfixion suture of No. 1 chromic catgut is placed in the sac neck at its junction with the pharynx and the ends left long (Fig. 3c and d). An additional braided silk tie is used for reinforcement when the sac neck is edematous or unusually large. After clamping a hemostat across the sac neck just distal to the ligature, the sac is severed between the ligature and hemostat (Fig. 3e). Phenol and alcohol are applied to the stump (Fig. 3f) following which the protective sponge previously placed is removed. The long ends

OSGOOD-SCHLATTER'S DISEASE

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A LARGE literature has accumulated on painful tibial tuberosities in the adolescent since attention was directed thereto by Osgood and Schlatter. The disorder is uncommon and save for a few notable exceptions (7, 8) reports have been based on very small series or even on single cases. The development of the tibial tuberosity is complex and an understanding of its normal anatomical features has been obscured by inaccurate descriptions. Moreover indications are rarely present for operative interference. For these reasons it is not surprising that there should be widely varying interpretations of the pathological changes which take place in the presence of Osgood Schlatter's disease.

THE ANATOMY OF THE TIBIAL TUBEROSITY

The tibial tuberosity has a proximal smooth (Fig 1 s) and a distal rough part (Fig 1 r). The proximal surface of the tuberosity is separated from the upper anterior surface of the tibia by a groove (Fig 1 g) that begins at the upper medial corner of the tuberosity, extends to and turns distally along the lateral side of the tubercle as far as the junction of the smooth and rough parts. This groove varies in depth from bone to bone but is constantly present.

The ligamentum patellae is inserted into the groove and into the smooth part. Investigation has proved that this insertion is strongest in the groove and less so in the tibial tuberosity (3). The deep infrapatellar bursa is related to the tibia immediately proximal to the groove (Fig 1 h); this bursal area may be poorly defined but in many cases stands actually to overshadow the tuberosity itself. The line of demarcation between the smooth and rough halves of the tuberosity lies obliquely like the groove extending farther distally on the lateral side. This line of demarcation indicates the

site of fusion which has taken place between the apophysis and diaphysis.

THE DEVELOPMENT OF THE TIBIAL TUBEROSITY

The conclusions in Table I are based on the examination of more than 100 x ray films. Interpretation of roentgenograms depicting such a small area is made difficult by the marked variation in the films resulting from projections at slightly different angles. The observations are in agreement with those of Perrot who conducted a similar investigation. The development of one or more apophyseal centers at the age of 11 years, their fusion with each other and with the epiphyseal tongue a few months later and the closure of the apophyso-epiphyseal line at about 15 years of age are now fairly generally accepted. Development proceeds a little more rapidly in females.

THE RADIOLOGICAL APPEARANCES IN ADOLESCENT PAINFUL TIBIAL TUBEROSITY

Since 1940 17 children seen at this hospital have been found to be suffering from the con-

Apophysis the term is used here to denote part of the epiphysis which ossifies from a separate center or centers.



Fig. Anatomy of tibial tuberosity: s Proximal smooth and r distal rough part; g groove; h bursal area.

From the Wingfield Morris Orthopaedic Hospital.
Dr. Hughes is holder of travelling fellowship of the National Health and Medical Research Council, Australia.

balance during the first few days additional fluids and vitamins are administered parenterally. The nasal tube is left in place for 18 days acting as a splint during the healing process. A day or two after its removal roentgenologic examination of swallowing function is done. By this time the operative site is healed and a soft diet readily tolerated.

COMPLICATIONS

Complications occurring in the early cases of this series have been described in previous reports (1, 2). Those occurring in the last 100 cases are listed in Table III. The most frequently observed complication was unilateral vocal cord paralysis which was temporary in all instances. The normal location of the recurrent nerve at the lower border of the inferior constrictor muscle is a vulnerable one. In 1 instance paralysis of the left vocal cord was present before operation. Injury to this nerve can only be minimized by exercising care during retraction of the thyroid gland and trachea, freeing of the sac and repair of the pharyngeal wall.

Only 1 of the wound infections did not respond readily to chemotherapy and local conservative measures. In this instance a fistula persisted for 10 weeks but then remained healed. Mediastinitis was not encountered in the entire series of 186 cases.

In several instances, postoperative roentgenologic examination revealed retention of a speck of barium at the operative site. These

dimples were not associated with stricture and the patients were considered cured. One patient, however, was well for 6 months, then had a mild recurrence of symptoms. Roentgenologic and esophagoscopy examinations revealed a pharyngeal sac which was deemed too small to warrant reoperation at that time. She was advised to return for follow up 6 months later but failed to do so.

In the entire series of 186 cases there were 5 deaths or a mortality of approximately 3 per cent. The causes were pneumonia in 2 instances, uremia in 1, uremia with parotitis in 1, and coronary occlusion in 1. It is therefore apparent that the mortality of one stage pharyngeal diverticulectomy is no greater than would be expected for any other major operation in this age group.

CONCLUSIONS

1. Combined surgical and esophagoscopic technique for the one stage removal of polypoid pharyngeal diverticulum herein described represents a sound anatomic and physiological approach to the treatment of this lesion.

2. Experience in 186 cases has shown this method to be safe and effective.

Since this paper was submitted for publication 4 additional patients have been operated upon with similar results.

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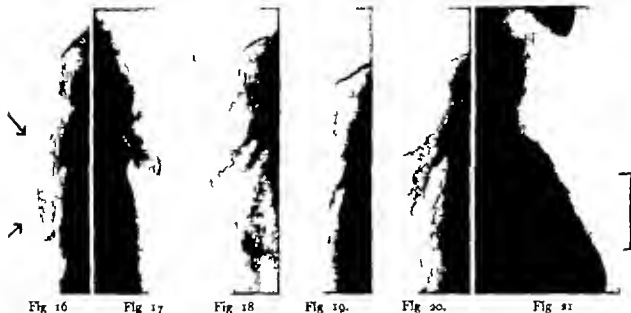


Fig. 16. Male, 14 years old.

Fig. 17. Female, 13 years old, left knee (see Fig. 18).

Fig. 18. Female, 13 years old, right knee (see Fig. 17).

Fig. 19. Male, 15 years old.

Fig. 20. Male, 15 years old.

Fig. 21. Male, 14 years old.

sis of the underlying bone is also shown (Figs 17 to 20) this rarefaction is localized to the surface of the apophysis.

THE PROGNOSIS IN ADOLESCENT PAINFUL TIBIAL TUBEROSITY

A small number of patients were re-examined at intervals varying from 1 to 9 years after the onset. 2 others, aged 26 and 34 respectively, sought advice for persistent recurrence of pain in the region of the tuberosity since adolescence. All these patients possessed a prominent tibial tuberosity (the photo-

graphs of the knees of 2 patients are reproduced in Figs. 22 and 23). The tuberosity in some cases was tender on palpation and about half of the patients experienced pain in this region which was precipitated by exercise by kneeling or even by sitting on a chair. A radiological examination showed an enlargement of the tuberosity at the site of the insertion of the ligamentum patellae frequently a separate ossicle was present within the ligamentum and an irregular buttress of bone tends to form just above the tuberosity posterior to the tendon (Figs. 24 to 32).



Fig. 22. Male, 15 years old (see Fig. 24).

Fig. 23. Male, 20 years old (see Figs. 27 and 28).

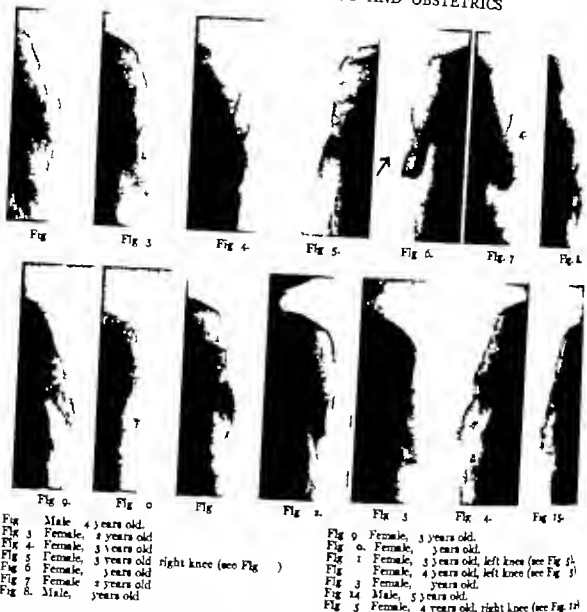


Fig. 1 Male, 4 years old.
 Fig. 2 Female, 2 years old.
 Fig. 3 Female, 3 years old.
 Fig. 4 Female, 3 years old.
 Fig. 5 Female, 3 years old.
 Fig. 6 Female, 3 years old.
 Fig. 7 Female, 2 years old.
 Fig. 8 Male, 3 years old.

right knee (see Fig. 1)

Fig. 9 Female, 3 years old.
 Fig. 10 Female, 3 years old.
 Fig. 11 Female, 3 years old, left knee (see Fig. 5).
 Fig. 12 Female, 4 years old, left knee (see Fig. 5).
 Fig. 13 Female, 3 years old.
 Fig. 14 Male, 5 years old.
 Fig. 15 Female, 4 years old, right knee (see Fig. 12).

dition (3 with bilateral involvement) The feature common in all the x ray films is either ossification within or enlargement of the ligamentum patellae. The ossification may be found at the site of insertion into the tuberosity in the ligament at a higher level or at both these sites. The abnormal bone at the ligamentous insertion may be in the form of a linear ridge (Figs. 2 to 10) a plaque of bone (Figs. 11-16) or mottled and irregular ossification (Figs. 17-20). The ossification situated higher in the ligament may be linear or irregular and may be connected with the bone for matum at the insertion by bridges of bone. In

the one x ray film which showed no ossification within the tendon (Fig. 21) there was demonstrated a kidney shaped opacity at the site of its insertion.

The epiphysis has united with the apophysis to form a continuous beak, indeed this formation is to be expected since it was found in the normal films of this 12 to 14 year age period (Table I and Fig. 33). The epiphyseal part of the beak is never primarily involved in pathological changes the apophysis also usually escapes. It was found that in those cases in which a mottled irregular ossification is displayed at the site of insertion some osteoporosis

TABLE I — THE DEVELOPMENT OF THE TIBIAL TUBEROSITY

Age group—years	Stage of development of tibia
0-6	The ossification of the epiphysis results in the formation of distinct the proximal end of the tibia diaphysis. There is no extension yet to form the epiphyseal part of the tubercle. The diaphyseal or rounded ball of the tuberosity may or may not be represented by a ledge.
6-8	The epiphysis increases slightly in depth in its anterior part. The diaphyseal ledge is more definite throughout it may be concealed by an oblique projection. The apophysis remains unossified.
8-10	A small tongue of ossification appears from the anterior and inferior edge of the epiphysis. In some films there appears to be an extension of ossification from the diaphyseal ledge into the lower part of the epiphysis but this appearance is due to the obliquity of the ledge.
10-12	The tongue of ossification from the epiphysis continues to extend distally. The distal part of the epiphysis ossifies in most cases from one or more centers. This epiphyseal ossification forms the prominent smooth part of the tubercle and joins the epiphyseal tongue. The site of the groove.
12-14	The epiphysis and epiphysis become continuous. The beak so formed varies very considerably in appearance as does its degree of separation from the diaphysis.
14-16	The line of separation between the combined epiphysis and epiphysis and the diaphysis is slowly obliterated. The oblique and vertical processes of this line appear to be the first to fuse, followed by fusion of the beak and diaphyseal ledge.

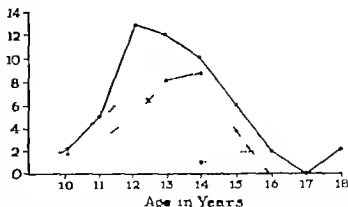


Fig. 33 The age incidence of 51 patients seen at this hospital, 1930-1946 inclusive and diagnosed as suffering from Osgood-Schlatter's disease. Total 51; females, 23; males, 28.

there is a disorganization of the apophyseal centers or actual avulsion of a fragment of bone. The finding by some authors that the first radiological sign of this disease is a thickening of the ligamentum patellae (1, 2, 7) the almost constant radiographic demonstration of opaque material within the ligament as described here and as seen in x ray films reproduced by others the increase in density of this material in successive x ray films clearly seen in some of our cases as well as in those published by others all favor the view that Osgood-Schlatter's disease is of the same pathology as myositis ossificans which occurs in the muscle and tendinous fibers of brachialis at the elbow.

With the great number of variations possible in the radiological appearances of the normal tuberosity it is most hazardous to diagnose Osgood-Schlatter's disease from such appearances as increased densities osteoporosis partial separation pitting irregularities and similar conditions. The appearance of fragmentation is a normal stage in the apophyseal development. Osgood-Schlatter's disease cannot be compared with osteochondritis of the hip where fragmentation is a radiological sign of disease. The only definite abnormality of the apophysis observed here was the osteoporosis of the surface at the site of insertion of the ligamentum; this was observed clearly in only 5 cases (Figs. 15, 17, 18, 19, 20) and its presence is accounted for by a reactive hyperemia at the site of the injury. A lack of clear definition of the tuberosity which is apparent

this osteoblastic reaction or to metaplasia of fibroblasts. In either case it would appear that the initiating stimulus is injury to the ligament direct or indirect.

This conception of Osgood-Schlatter's disease as a tendinitis ossificans is in full accordance with all the known facts. Children are affected at an age when osteoblastic activity of this area is at a maximum. The slightly earlier incidence in girls corresponds to their earlier development (Fig. 33). Injury may or may not be recalled but this is an age period when such recollection is difficult. Pain at rest and during exercise a tender enlarged tuberosity the characteristic radiological features all receive an adequate explanation.

Trauma was believed by both Osgood and Schlatter to be the cause of the painful tuberosity and this opinion is now regarded as correct. But its mechanism in the production of the condition has not been clearly understood. Some believe that it causes separation of the tongue-like epiphysis from the diaphysis or even fractures the epiphyseal beak. Others believe that the injury interferes with the blood supply and so causes an aseptic necrosis of the apophysis while others again consider that

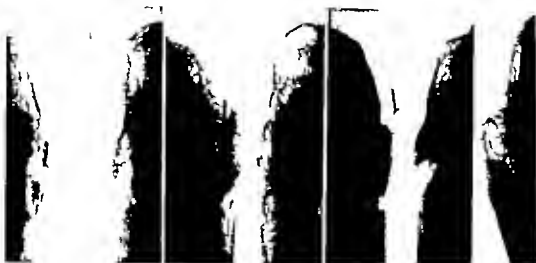


Fig. 24.

Fig. 25.

Fig. 26.

Fig. 27.

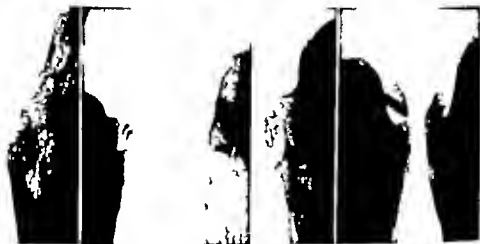


Fig. 28.

Fig. 29.

Fig. 30.

Fig. 31.

Fig. 32.

Fig. 24. Male, 5 years old. Same case as in Figure 3 unaffected knee shown.

Fig. 25. Female, 5 years old. Same case as in Figure 3 unaffected knee shown.

Fig. 26. Female, 3 years old. Same case as in Figure 3, unaffected knee shown.

Fig. 27. Male, 20 years old. Left knee (see Fig. 28).

Fig. 28. Male, 20 years old, right knee (see Fig. 27).

Fig. 29. Female, 8 years old. Same as in Figure 28.

Fig. 30. Male, 34 years old.

Fig. 31. Male, 20 years old.

Fig. 32. Female, 7 years old. Same case as in Figure 27 and 28. Left and right knees.

DISCUSSION

A knowledge of the normal anatomical and radiological features of the tibial tuberosity in the varying stages of its development is indispensable if the true nature of Osgood-Schlatter's disease is to be understood.

The investigation recorded here shows clearly that the clinical features of this affection are almost certainly due to a pathological change primarily within the ligamentum patellae

rather than in the apophysis. The ossification at the site of insertion is readily accounted for by the partial tearing of the ligamentum from the bone. The insertion of this tendon into the smooth portion of the tuberosity is not as firm as it is into the groove (3) and this may well be the cause of the involvement of the former and the sparing of the latter as seen in most of the early x ray films. The ossification higher in the ligament may be due to an extension of

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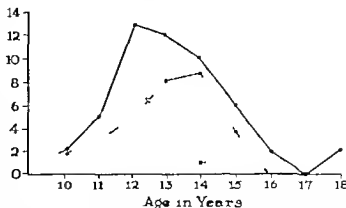


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in some of the roentgenograms can be attributed to the presence of changes in the overlying soft tissues

It may be concluded that there is the strongest evidence in support of the belief that Osgood Schlatter's disease is primarily an intraligamentous rather than an epiphyseal condition

SUMMARY

1 The normal anatomy of the tibial tuberosity and the insertion of the ligamentum patellae have been reviewed

2 The development of the tuberosity has been traced radiologically

3 From a study of the condition in the knees it is concluded that the essential lesion in Osgood Schlatter's disease is a "tenositis" rather than an epiphysitis.

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BARTHOLIN CYST

A Simple Method for its Restoration to Function

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THE vulvovaginal gland (Bartholin) is a racemose gland lying beneath the labia minora. It secretes a clear viscid fluid through its ostium which is located superficial to the hymen in the region of 5 and 7 o'clock. The purpose of the secretion is to lubricate the vulva. As with all glands the amount of secretion varies from time to time but generally speaking the amount of secretion is indicative of the interest in mating.

Bartholin's gland may become diseased and be converted into a cystic formation. Should the cyst become secondarily infected an abscess may result. The latter is limited to the gland and its duct. It rarely extends to the adjacent tissues such as an infection by the streptococcus would produce.

Because of the location of the gland in the vulva disease of this structure should not be interpreted as *prima facie* evidence of a venereal infection. The *Micrococcus catarrhals* is frequently the invading organism in the simple cyst and in the purulent involvement the culture is usually sterile and rarely shows the presence of the gonococcus.

The conversion of the small racemose gland and its duct into a large cyst or abscess suggests a mild infective process originating in or near the minute opening of the vulvovaginal gland which through inflammatory changes occludes the opening of the duct (ostium). The rhythmic secretion of the gland blocked by the occlusion of the duct at its ostium distends the duct and converts it into an apparently large thin walled cystic mass. The patient may frequently detect a periodicity in the distention and regression in the size of the cyst such a rhythm suggests that the gland has not been destroyed by pressure necrosis but that the secreting cells are responding to normal physiological processes.

It should be the objective of the gynecologist to conserve the function of the diseased gland because of its importance in the intelligent interpretation of waves of interest monotonous or fatigue which are present in varying degrees during the process of mating. They are revealed to the male by the presence of lubrication or dryness of the vulva and should suggest a continuation of the mating process or a short period of rest which should be followed by another method of approach if the fullest mental and physical reaction is desired for the female.

The use of vaseline as a lubricant following the surgical removal of the diseased gland may prevent trauma due to dryness and friction but it does not encourage emotional interpretation. The sex act unfortunately frequently becomes a habit and the use of vaseline encourages the routine sex act which tends to become tiresome and fatiguing instead of being enjoyable and stimulating.

Sterility due to tubal spasticity frequently requires consultation with a psychiatrist. His treatment is enhanced by a normally functioning gland which tends to prevent tubal spasticity resulting from friction and trauma.

The restoration of the diseased gland to normal without surgical removal requires an intelligent interpretation of the pathological process responsible for the formation of the cyst as well as an accurate anatomical background. Casper Bartholin (1655-1738) of Copenhagen, Denmark, described the gland but it remained inaccurately described until Bern Gallaudet of Columbia University showed that the gland was a homologue of Cowper's gland and that it lay deep to the bulbos cavernosus muscle and the bulb in the deep compartment of the perineum, i.e. on the deep transverse perineal muscle. Being restrained by the superficial and deep layers of the uro-

in some of the roentgenograms can be attributed to the presence of changes in the overlying soft tissues.

It may be concluded that there is the strongest evidence in support of the belief that Osgood Schlatter's disease is primarily an intraligamentous rather than an epiphyseal condition.

SUMMARY

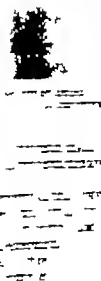
1. The normal anatomy of the tibial tuberosity and the insertion of the ligamentum patellae have been reviewed.

2. The development of the tuberosity has been traced radiologically.

3. From a study of the knees it is concluded that the disease is Osgood Schlatter's rather than an epiphyseal condition.

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remaining secretory cells to regenerate and function

Twenty five cases have been treated by incision close to the hymen in the region of the opening of the duct. The cavity of the cyst is then packed with iodoform gauze which is removed and replaced biweekly for approximately 3 weeks. At the end of this time an opening admitting the blunt end of a pencil represents the newly constructed ostium. The packing prevents the small incision from agglutinating and permits epithelization of the new ostium with squamous epithelium. Ample drainage should permit the diseased gland to return to normal and require no further treatment, but occasionally the ostium may contract and necessitate dilatation with a blunt instrument. The restoration to normal is verified by the disappearance of the mass and the presence of a clear viscid secretion in the region of the fossa navicularis.

COMMENTS

Drainage of the diseased duct is readily accomplished by infiltration with a local anesthetic and incision either in the hospital or in the office depending on the type of patient to be treated. To facilitate packing the edges of the incision should be held with clamps so that the collapsed cyst may not retract into the deeper tissues.

Since the treatment is usually performed in the office confinement to bed is not required.

No case in which this method of treatment was carried out has been complicated by postoperative hemorrhage either immediately following the incision or several days later. The author is familiar with several cases of severe postoperative hemorrhage following the surgical removal of the cyst which required transfusion, packing and even resuturing before the bleeding could be controlled.

CONCLUSIONS

The so called cyst or abscess of Bartholin's gland actually consists of a dilatation of the duct of the gland.

The periodical swelling and recession of the cyst suggest occlusion of the ostium with intermittent drainage.

The swelling of the cyst suggests activity of the secreting cells which lie between the layers of the urogenital diaphragm.

The purpose of the incision and packing of the cyst cavity is to permit restoration of function by the construction of a patent ostium.

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Fig. 1. An incision has been made into the cyst close to its original ostium. A strip of iodoform gauze fills the cavity of the evacuated cyst.

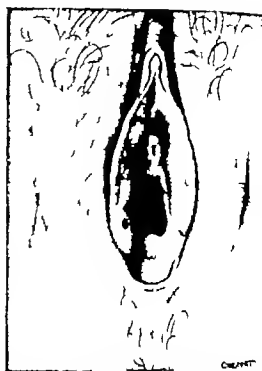


Fig. 2. Appearance of the new ostium, 3 months after incision. Five replacements of the packing are required to effect the permanent ostium.

genital diaphragm (triangular ligament) it is impossible for the gland to dissect between the resistant layers to enlarge and become cystic. Instead it is the duct of the gland which becomes distended as it traverses the loose connective tissues between the gland *per se* and its ostium. In the superficial perineal pouch the loose tissues are readily distorted and the dilated cystic duct may cause considerable distortion of the bulb, bulbocavernosus muscle and the labia.

Microscopic study verifies the anatomical finding that the cyst is confined to the duct. Normally the epithelial lining of the Bartholin gland is of the columnar variety while that of the duct is transitional epithelium. The latter variety and even squamous epithelium lines the cavity of enucleated cysts. Careful examination of extensively dissected specimens may reveal a small nodule attached to the cyst which nodule is lined with columnar epithelium. It represents the gland proper.

The final picture is one in which the minute gland lying between the resistant layers of the urogenital diaphragm communicates with a

greatly distended duct which distorts the labia and is adherent to the vulva at the site of its occluded ostium.

Careful surgical removal of the cyst usually results in a rupture of the cyst at its ostium which is in the region of 5 or 7 o'clock and at its attachment to the secreting diaphragm. As a rule the gland *per se* is not removed but the scar tissue resulting from the operative procedure may completely occlude the gland and cause its atrophy.

The author was taught to assume that each case more likely than not, was the result of a venereal infection and that complete enucleation was the treatment of choice. After being consulted by several patients whose complaint was dyspareunia following the bilateral enucleation of Bartholin's cysts, he was influenced by the anatomical position, microscopic study and the frequency of negative cultural reports to change his form of treatment from that of complete excision of the cyst to that of ample drainage and the construction of a permanent ostium which would completely drain the diseased duct and permit the

remaining secretory cells to regenerate and function

Twenty five cases have been treated by incision close to the hymen in the region of the opening of the duct. The cavity of the cyst is then packed with iodoform gauze which is removed and replaced biweekly for approximately 3 weeks. At the end of this time an opening admitting the blunt end of a pencil represents the newly constructed ostium. The packing prevents the small incision from agglutinating and permits epithelization of the new ostium with squamous epithelium. Ample drainage should permit the diseased gland to return to normal and require no further treatment but occasionally the ostium may contract and necessitate dilatation with a blunt instrument. The restoration to normal is verified by the disappearance of the mass and the presence of a clear viscid secretion in the region of the fossa navicularis.

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RESULTS AND CAUSES OF FAILURE OF RADIATION THERAPY IN CARCINOMA OF THE CERVIX

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THE combined use of roentgen radiation externally and surface radium application internally has long been widely accepted as the method of choice for the treatment of cervical carcinoma. In recent years, however, this technique has been challenged and a number of other methods including a return to radical surgery have been strongly advocated. Thus the subject has again become a matter of controversy which can be settled only by impartial appraisal and analysis of the 5 year survival rates in comparable series of patients treated by each of the available methods. To this end additional data will be essential for present evidence does not yet permit any final conclusions about the optimal form of treatment in cancer of the cervix. These considerations prompted the present report dealing with survival rates, complications and possible causes of failure in a series of patients treated at the New Haven Hospital, a general hospital of 510 beds during the years 1934 to 1941 inclusive.

CLASSIFICATION OF PATIENTS

One hundred fourteen patients with cervical cancer were treated during this period. Of these 88 were ward patients who received primary radiation therapy. In addition there were 12 private patients, 9 others whose primary treatment was given elsewhere and who were admitted with advanced or terminal disease and 4 patients in whom the diagnosis of carcinoma of the cervix was not clearly established by biopsy. In 1 patient a very early lesion was first discovered in the surgical specimen after total hysterectomy. These miscellaneous groups have been omitted from further study and our attention has been centered on the 88 ward patients because a relatively homogeneous and uniform treatment

plan and clinical work up program was adhered to in this group and because their follow up data are most complete.

The ages of the 88 patients in this selected group ranged from 25 to 81 years, with the greatest concentration of cases in the two decades 40 to 49 years and 50 to 59 years. The distribution by decades, and the number of 5 year survivals per decade are presented in Table I. It can be seen that the age of the patient *per se* was not of great prognostic significance. With the exception of patients in the youngest decade these results are in accord with those reported for a larger series by Healy and Frazell.¹ This finding is at variance with the widespread notion that the outlook for very young patients with cervical cancer is particularly unfavorable. Such patients merit just as prompt aggressive and thorough treatment as women over 50 years of age.

TABLE I — AGE AND SURVIVAL DISTRIBUTIONS BY DECADES

Age, years	20-29	30-39	40-49	50-59	60-69	70-79	80 and over
No. patients	3	6	8	5	5	5	1
5 year survivals	—	6	8	4	5	—	—
Survival per cent	66	100	100	80	100	—	—

Bleeding of variable severity was by far the most common presenting symptom. Aching pain in the lower back or pelvis and foul vaginal discharge were also frequent complaints, while weight loss of significant degree was seldom observed initially. Four patients had no symptoms referable to their tumors; these were detected only during routine physical examinations for unrelated complaints. The duration of symptoms prior to diagnosis varied from a few days to a few years, but this factor appeared to have little or no relation to prognosis or to the extent of disease on initial examination. The fact that the survival rate in

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patients with symptoms for over 2 years was just as high as that in patients in whom the diagnosis was made 'earlier' is probably best explained by variations in the growth rates of the tumors and in the ease with which they bleed.

CLINICAL EVALUATION AND METHOD OF TREATMENT

The patients are usually referred from the admitting clinics or from other services where they have been seen. Although the hospital maintains a general tumor clinic staffed by radiologists, pathologists and surgeons it has been found more convenient to send these individuals to a special tumor clinic operated by the Department of Obstetrics and Gynecology in which patients with neoplasms of the female genital tract are examined, prepared for treatment, and subsequently followed. In addition a central tumor registry supported by grants from the Jane Coffin Childs Fund for Medical Research, maintains a crossfile index of all tumor cases and is charged with the responsibility of getting patients back regularly for periodic follow up examinations.

Patients with suspected cervical cancer are examined bimanually in the special clinic and if this examination is confirmatory, are admitted to the hospital as emergency cases. There, a detailed history is taken and a complete physical examination and biopsy of the cervix are performed. When the biopsy is reported positive for carcinoma the patient is subjected routinely to all of the following diagnostic procedures (1) cystoscopy (2) intravenous urography (retrograde also when necessary) (3) sigmoidoscopy and (4) roentgen examination for metastases which includes a posteroanterior chest film anteroposterior and lateral films of the abdomen pelvis and lumbosacral spine and a single lateral view of the skull. When all of this information concerning the patient is available she is seen jointly by the tumor therapy representatives of the Departments of Obstetrics and Gynecology and of Radiology who perform a careful abdominorectovaginal examination to map out the extent of palpable disease and then reach a decision concerning the optimum method of treatment in each particular case.

Cases have been classified according to the League of Nations plan.

Although an attempt is made to individualize treatment attention is also directed to the dangers of excessive empirical variation in technique and a relatively routinized method has been employed wherever possible in order to facilitate subsequent evaluation of results.

In the usual case treatment starts with external roentgen therapy. It is generally agreed that roentgen radiation should precede rather than follow radium application because it reduces infection in the primary tumor, causes its regression, thus facilitating subsequent radium insertion and tends to seal off the parametrial lymphatics, slowing the spread of disease. Following the recommendations of Arneson and Quimby (2) which were based on a study of the physical distribution of external roentgen radiation in the pelvis 6 portals (2 anterior 2 posterior and 2 lateral) have been employed on all patients whose anteroposterior abdominal measurement was 20 centimeters or more. The lateral portals have been omitted on thinner patients. The usual portal size has been 10 by 15 centimeters, with the inferior outer corner shielded off by lead on the anterior and posterior fields to protect the femoral head. The physical factors have been 200 kilovolts pressure, 20 milliamperes 70 centimeters distance $\frac{1}{8}$ millimeter of copper plus 1 millimeter of aluminum added filtration output 22 roentgens per minute. After the first pelvic cycle of 6 daily treatments 2 portals are treated daily each receiving approximately 250 roentgens. Thus in a 3 to 4 week period a total dose of 1500 to 1800 roentgens measured in air, is delivered to each of the 4 to 6 portals.

The patient is seen in the gynecological tumor clinic 2 to 4 weeks after the completion of x ray therapy re-examined and scheduled for hospital admission and radium insertion. Ordinarily repeat biopsies are not done during or after treatment as it is felt that they may interfere with the healing process and possibly break down fibrous barriers around damaged but still viable cancer tissue.

Radium insertion has been performed under general anesthesia about 4 to 6 weeks after the course of roentgen therapy is finished. This

time interval was selected to permit maximal regression of the tumor and subsidence of the radiation reaction with the feeling that radium application would thus be facilitated and late injuries minimized. The question of the optimal interval between external therapy and radium insertion will be treated at greater length in the discussion below.

For the treatment of cervical cancer platinum cells having a total length of 12 millimeters, an active length of 11 millimeters and a wall thickness of 0.2 millimeter and each containing 3.33 milligrams of radium are enclosed in platinum tubes having a wall thickness of 0.3 millimeter, an active length of 12 millimeters and an overall length of 15 millimeters. Each platinum tube holds either 4 or 8 cells. These tubes are then placed individually in hollow brass cylinders 7 millimeters in diameter about 20 millimeters in overall length each having a wall thickness of 2 millimeters (0.5 mm. pt. equivalent). Thus the total metallic filtration is equivalent to 1.0 millimeter of platinum.

For intrauterine application 2 or 3 cylinders are inserted in tandem into a short length of black rubber tubing which is then tied off at both ends. Eight radium cells are usually placed in the inferior cylinder which lies close to the lower end of the uterine canal and only 4 cells in the upper cylinders. Cylinders, containing 4 cells each are also placed in the hollow rubber corks of a conventional colpostat, and where possible in a third rubber cork which is placed inside the circle of the colpostat bridge against the external os of the cervix. This is essentially the Paris technique developed by Regaud and others. After insertion of the radium the vagina is carefully packed with sulfathiazole-impregnated gauze packing care being taken to displace the bladder and rectum as far from the radium sources as possible. An indwelling catheter is left in the bladder.

In those cases in which the extent of the tumor does not interfere with the standard radium application described a total dosage of 6,000 milligram hours has been employed divided equally between the tandem and colpostat. In the years 1934 to 1936 it was customary to insert the tandem first followed

after an interval of 4 or 5 days by the introduction of the colpostat. More recently both applicators have been used simultaneously the total duration of radium exposure is approximately 70 hours.

Seventeen of the 88 patients received no radium therapy because due either to the local extent of disease or to systemic complications it was felt that radium therapy would not add to the palliation effected by external roentgen treatment alone. Conversely 6 early lesions in which the disease was apparently confined to the cervix were treated by radium alone. In a small number of cases in which combined roentgen and radium therapy was planned, either one or the other was not completed, owing to the development of complications, to failure of the patient to return for treatment, or to errors in follow up. Thus a net total of 58 patients received a full course of radium treatment and 52 of these also received roentgen therapy in the usual dosage range.

RESULTS

The results of radiation therapy in the series of 88 primary ward cases are summarized in Table II. The 5 year survival rates, expressed as percentages of the determinate group, are: 69 per cent for Stage I, 47 per cent for Stage II, 4 per cent in Stage III and 0.0 per cent in Stage IV. The net 5 year survival rate for the entire series was 38 per cent.

In 3 instances, patients who had survived 5 years developed recurrences and died of cancer after 6, 7 and 10 years, respectively. One other patient is living with extensive recurrent disease 7 years after treatment. It is generally accepted that about 10 per cent of those with cervical cancer who survive 5 years will subsequently die of the disease. About half of the patients in our group of survivors have now been followed for 8 to 13 years.

Complications. The number of recorded complications in this series was surprisingly small and they appear to be complications of the disease process itself rather than the result of treatment. Two patients had a second primary cancer, one arose in the ovary the other in the breast. These were both far advanced when the cervical cancer was detected and only palliative treatment could be given.

TABLE II—RESULTS OF RADIATION THERAPY IN 83 CASES OF CERVICAL CANCER

	Stage I		Stage II		Stage III		Stage IV		Total	
	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent	Cases	Per cent
Total primary ward patients	27	100	7	100	5	100	0	100	39	100
Lost to follow-up	1	?								
Dead of other causes		?								
Determinant group	25	93	7	100	5	100	0	100	37	95
Dead of cancer less than 5 years		1	0	0*	2	40*	0	0*	2	5*
Dead of cancer more than 5 years	3								3	
Alive—5 years	1	60	7	100*	3	60	0	0*	11	30*

*Percentages of the determinant group

One patient who survived 5 years subsequently developed a basal cell carcinoma of the skin of the face which was recently treated.

The presence of vaginal fistulas communicating with either the rectum or bladder at the time of death was recorded in 3 patients. All of these fistulas developed long after radiation therapy in areas of extensive neoplastic involvement and it seems reasonable to conclude that they resulted from the disease rather than from radionecrosis. There were no instances of fistulas or intestinal stricture obstruction or perforation which could be attributed to the radiation therapy employed. These results contrast favorably with the incidence of radiation injuries and fistulas reported elsewhere. Smith found a higher incidence of fistulas in untreated patients than in patients treated with radium and roentgen rays in fractionated or massive doses and concluded that most fistulas can be considered part of the natural course of the disease. That certain methods of treatment are attended by a significantly greater hazard of fistula formation is indicated by the reports of Pitts and Waterman (15), who observed 29 fistulas in 373 patients treated by interstitial radium implantation with or without supplementary roentgen therapy. Recently Meigs (8) advocated a return to the Wertheim operation in the treatment of early cancers of the cervix. Although the mortality in his series of 53 patients was only 1.9 per cent, he noted 5 ureterovaginal fistulas, an incidence of 10.6 per cent. Corcaden Kasabach and Lenz found that the incidence of intestinal radiation in

juries could be brought down from 8.7 per cent to zero by increasing the time and reducing the intensity of treatment. It seems reasonable to conclude that fistulas and other complications may occur as the result of the technique and dosage employed but are not an inevitable sequel to all radiation therapy for cervical cancer.

Metastases Despite the contrary evidence provided by a number of studies in advanced cervical cancer, the clinical impression still persists that remote metastases from carcinoma of the cervix are uncommon. Behney noted distant metastasis in 4.4 per cent of a series of untreated patients and in 21 per cent of treated patients coming to autopsy. Pearson has reviewed the earlier literature on this subject and added his findings in 57 cases of cervical cancer examined postmortem. In this group there were 13 (25 per cent) with remote metastases to the liver, lungs, pleura, peritoneum, kidney, bones or spleen.

In the series reported here 56 patients died of cancer and 13 of these (23.2 per cent) are known to have had distant metastases at autopsy. The actual incidence is undoubtedly higher inasmuch as many patients died at home where postmortem examination was not possible. At the time of treatment 5 of these 13 cases had been classified as Stage I, 1 as Stage II, 4 as Stage III and 3 as Stage IV but all were clinically very extensive by the time death occurred or metastases were noted. Thus remote metastasis is a rather frequent event in carcinoma of the cervix, particularly in relatively advanced cases.

able have interfered with the administration of a full course of treatment in many cases. A review of these instances reveals that 3 patients failed to return for radium therapy at the appointed time and through an oversight, were not sent for through social service channels. These cases were classified as Stage I, II and III respectively, and all 3 failed to survive 5 years. In 4 other Stage I cases, an interval of 2 to 12 months was allowed to elapse between roentgen and radium therapy for similar reasons, but radium was ultimately applied and 3 of these patients are still alive.

Ten patients received incomplete radium therapy as a result of the omission of either the tandem or colpostat. In most instances this was due to difficulty encountered in the insertion of the applicators into a stenotic external os or vaginal vault or to the presence of a stump carcinoma with a short uterine canal. The net result was an inadequate total dose and unsatisfactory distribution of the radiation which should have been corrected in part by an increase in dosage from the other applicators and their reinsertion if necessary after a short interval. These 10 cases were classified in Stages I to III and none of these patients survived 5 years.

Finally a group of 17 patients (9 Stage IV, 6 Stage III, 2 Stage II) received no radium treatment because they were regarded as too far advanced or too old for anything but palliative external radiation. One of the patients with a Stage II lesion was 81 years old at the time of treatment and is still alive and well 11 years later. None of the other 16 patients survived 5 years. In the other patient with a Stage II lesion the coexistence of an extensive inoperable ovarian carcinoma was the reason for withholding radium. While it cannot be doubted that overenthusiastic treatment of patients with Stage IV cancers of the cervix often does more harm than good, it is also true that better palliation can be achieved in some instances by the use of radium as well as external roentgen therapy and the omission of radium in Stage III cases deprives about 1 patient in 4 of a chance for a 5 year survival. Obviously extreme debility or constitutional infirmities may contraindicate the insertion of radium even in patients in whom the local ex-

tent of disease is not great. This situation did not obtain in the majority of patients from whom radium was withheld. In view of our poor results in Stage III and IV cases, the decision to omit radium therapy in almost one half of such patients appears to have been unduly conservative.

We may now consider the possible flaws in our basic plan of using external roentgen therapy followed after an interval of 4 to 6 weeks by the insertion of radium according to the Paris technique. Sandler (16) has clearly indicated the extent to which the width of the upper vagina may influence the radium dosage delivered to various points in the lateral parts of the true pelvis. It is a common observation that stenosis of the upper vagina may follow external roentgen therapy and in a few instances in this series subsequent radium treatment had to be modified or abandoned because of this complication. This stenosis appears to progress rapidly within a few weeks after radiation and a relatively long interval between roentgen and radium therapy therefore tends to increase the frequency with which the condition is encountered when radium insertion is attempted. Secondly after the relatively long interval of 6 weeks almost all of the tissue reaction to preliminary roentgen therapy has disappeared, and a given dose of radium at this time will be relatively less effective than the same dose administered 1 or 2 weeks after the course of roentgen radiation. Thus a relatively long interval has the two-fold effect of decreasing the biological response to a given dose of radium at the same time that it increases the difficulty of applying such a dose.

On the other hand it is to be expected that a shorter interval between x ray and radium treatment will be attended by a greater incidence of radiation injuries as the work of Corraden, Kasabach and Lenz has indicated. A delicate balance must therefore be struck and an interval selected which will afford maximal effectiveness coupled with reasonable safety. In our series the number of complications which could properly be charged to radiation injury was extremely small but this alone does not compensate for the poor survival rates in the relatively advanced cases. Sandler (17) and Tod (23) at the Holt Radium Institute

roentgen dosage to various points in the pelvis is facilitated with these standard applicators. For these reasons a thorough trial of the Manchester technique by American clinics would seem indicated.

Several years ago Merritt advocated the substitution of intravaginal roentgen therapy for radium in the treatment of cervical cancer. Because of difficulty in directing the beam laterally especially in patients with a narrow vaginal vault the distribution of radiation in the pelvis was found to be inferior to that obtained with standard radium techniques (11). Recently however a combined method has been tried at the Memorial Hospital, New York in which the intrauterine radium tandem is still employed and only the vaginal applicators (colpostats, bombs, boxes) are replaced by intravaginal roentgen therapy. Initial reports on this modification as cited above, seem quite favorable (22).

In 1945 Meigs (8) boldly challenged the accepted radiotherapeutic techniques and suggested a return to the radical panhysterectomy of Wertheim. At the time of his report he had performed this operation in 47 elective cases with no deaths and in 6 nonelective cases with 1 death. This low mortality sharply emphasized the advances made by surgery through the introduction of improved operative techniques, more scientific preoperative and postoperative care and the advent of chemotherapy. For years the chief argument against the Wertheim procedure was the high mortality with which it was attended even in the best hands. It is clear that the situation has changed and that the place of surgery in the treatment of cervical carcinoma is in need of re-evaluation. It is not likely however that this method will supplant radiation therapy to any large extent because such low mortality rates can be achieved only by highly experienced surgeons who carefully select their cases. Meigs required his elective cases to be thin, young, in good health and to have an early tumor. The majority of his patients apparently had early Stage I lesions, which are also most susceptible to radiation therapy. One of the prime reasons cited by Meigs for his return to surgery is the frequency with which the pelvic lymph nodes are involved by

occult cancer which he believes, cannot be eradicated by radiotherapy. In his series of 53 patients examination of the lymph nodes in the operative specimen revealed cancer in 8 (17 per cent) but the clinical stage of disease in these cases is not stated. Obviously no final evaluation of the revived Wertheim operation can be made until 5 year survival rates are available for a large series of cases carefully classified by stages. On a *a priori* consideration however it appears that prohibitive mortality rates will limit its use to early cases in which lymph nodes are less often involved and for which suitable radium therapy already offers a very good prognosis.

For many years Taussig (19, 20) advocated iliac lymphadenectomy as a supplementary measure in the treatment of carcinoma of the cervix. Recent improvements in the operative technique have made this a rather simple, safe extraperitoneal procedure which permits the eradication of pelvic lymph nodes almost as effectively as the much more extensive Wertheim operation. The claim by many surgeons that present methods of radiation therapy cannot eradicate cancer in the pelvic lymph nodes is not without foundation. It is generally agreed that metastatic cancer in the submaxillary and cervical nodes cannot be completely destroyed by external radiation alone and that such deposits are best treated by radical neck dissection. The situation in the pelvis is highly analogous to that in the neck, particularly since most of the tumors are epidermoid carcinomas similar to those arising in the mouth. On this basis alone it would seem illogical to expect external radiation (which includes surface radium therapy as well) to accomplish in the pelvic nodes what it cannot do in the neck.

Further support for this point of view is furnished by a comparison of the survival rates and the frequency of lymph node involvement in cancer of the cervix. In Stage I cases 5 year survival rates have ranged between 60 and 100 per cent, with a rough average for the larger series at about 70 per cent. In Stage II a similar estimate would be about 45 per cent, and in Stage III, about 25 per cent. Taylor (21) has reviewed the literature pertaining to the frequency of pelvic lymph node involve-

ment. He found that regional metastases had occurred in about one third of operable cases, and that the incidence of involvement jumped from about 15 per cent in patients in whom the parametria were microscopically free of cancer to 35 to 55 per cent when one or both parametria were directly invaded. If allowance is made for patients dying because of failure to control the primary lesion it is clear that most of the deaths from cervical cancer could be accounted for on the basis of uncontrolled lymph node involvement.

It seems probable therefore that combined roentgen and radium therapy as employed today is incapable of eradicating cancer in the pelvic lymph nodes. More widespread recognition of this fact will undoubtedly result in a renewed trend toward surgery. It would seem that in Stages I, II, and III a combination of radium and roentgen therapy directed at the primary lesion and its direct lateral extensions followed by extraperitoneal lymphadenectomy to clean out possible regional metastases would be a conservative and probably effective step in the right direction.

SUMMARY AND CONCLUSIONS

1. The results in a series of 88 patients with carcinoma of the cervix treated by combined roentgen and radium therapy in a general hospital have been reviewed. The net 5 year survival rate for the whole group was 38 per cent which compares favorably with that reported elsewhere. However when analyzed by stages, almost all of the 5 year survivals were noted to have occurred in the disproportionately large group of operable Stage I and II cases, and the results in more advanced cases are thus shown to have been unsatisfactory.

2. Possible technical modifications which might yield better results are discussed and it

is concluded that the interval between roentgen and radium therapy should be shortened from 6 weeks to 2 weeks or less, that radium dosage should be increased somewhat in advanced cases, that the "Manchester technique" of radium application should be adopted and that extraperitoneal lymphadenectomy should be performed after irradiation in Stages I, II, and III to save patients with regional lymph node involvement.

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EXPERIMENTAL STUDY ON LIPOCAIC

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AS a result of experimental studies on fatty infiltration of the liver caused by the removal of the pancreas in dogs Dragstedt and associates (8-11) reported having obtained a fat free alcoholic extract from fresh beef pancreas, with which they claimed to have prevented fatty degeneration of the liver and death of depancreatized dogs that had received insulin and were fed on bread milk and meat.

As choline was not the specific principle of this extract nor was it to be found in the pancreatic juice or in the extracts of other organs with a rich lipid content (brain liver) and in view of the fact that it was found to be active in small doses per os Dragstedt considered it to be a pancreatic hormone different from insulin and indispensable to the normal metabolism of lipids moreover he suggested the name lipocaic for it (11). According to Dragstedt daily doses of 1 to 1.5 grams of the original preparation (equivalent to 100 grams of fresh pancreas) given by mouth prevented or cured a gross lipid surcharge of the liver and other typical symptoms present in depancreatized dogs treated with insulin.

Dragstedt's hormonal theory based on experimental evidence not entirely unassailable was subjected to numerous criticisms. Some of these were successfully answered by him and his co-workers (9-12) but other questions are still open to discussion partly owing to a lack of uniformity among authors not only concerning the methods used for giving rise to fatty infiltration of the liver but also regarding the diets given to animals.

Though the hormonal character of lipocaic is still denied by some experiments carried out on various types of laboratory animals—particularly on dogs and rats—prove that Dragstedt's extract has an unquestionable lipotropic activity which is not due to the pres-

ence of insulin lecithin choline proteins (6, 7, 31) methionine (7) or inositol (25, 30).

Our work was undertaken with the purpose of studying experimentally (a) the metabolic changes occurring in dogs with ligated pancreatic ducts (b) the repercussions which this operation has on the chemical composition of blood, and (c) the preventive and healing effects that the lipotropic principle of the pancreatic extract—prepared after Dragstedt's technique—has on both (a) and (b). Following other authors' footsteps we started by studying the variations of the cholesterol and phospholipid content of the blood of these animals with the object of endeavoring to establish a quantitative relationship between these and the dose of extract administered.

The first observations suggested that the ligation in dogs of the excretory ducts of the pancreas because of the fatty infiltration of the liver it caused (1, 2, 16, 24, 26, 28, 29) necessarily had to produce some changes in the functional activity of this organ. Therefore we carried out further researches on both the prothrombin variations and the blood alkaline phosphatase activity. In some cases we also determined the serum proteins in order to investigate the effect of their decrease on the alterations already observed.

METHODS

The experiments were performed on 10 normal dogs of different sizes in which the pancreatic ducts were ligated according to the technique advocated by Montgomery, Entenman and Chaikoff. A 10 centimeter long mid line incision was made the cut being carried right down to the peritoneum. Once the entire duodenum and pancreas had been delivered and the duct of Wirsung and accessory ducts came into view they were cut between two cotton ligatures. All pancreatic attachments to the duodenum were severed the dissection was carried down to a distance of 2

ment. He found that regional metastases had occurred in about one third of operable cases and that the incidence of involvement jumped from about 15 per cent in patients in whom the parametria were microscopically free of cancer to 35 to 55 per cent when one or both parametria were directly invaded. If allowance is made for patients dying because of failure to control the primary lesion, it is clear that most of the deaths from cervical cancer could be accounted for on the basis of uncontrolled lymph node involvement.

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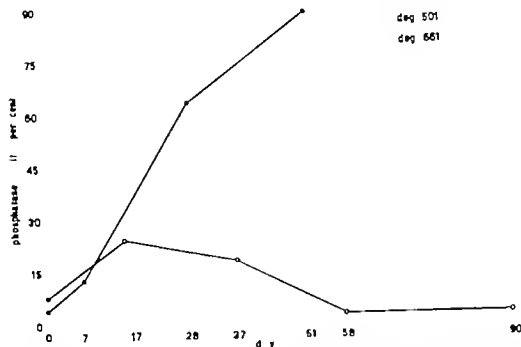


Chart 1. Increase in the alkaline phosphatase of serum of the untreated animals (such as in dog 501). Note the difference between the animal treated with lipocaic (dog 661).

For calculating the yield in terms of extract with sugar, it must be taken into account that 60 grams (30 %) of sugar are added to the 200 grams of fluid extract, thus the yield will be 52 per cent.

Bearing in mind these results the following relation may be established: 1 gram of extract with sugar = 0.77 gram of fluid extract = 0.538 gram of dry extract (Dragstedt's lipocaic) therefore one of our capsules containing an average of 0.75 gram of extract with sugar is equivalent to 0.4 gram of dry extract or to 14.3 grams of fresh pancreas.

Characteristics of the extract. The sugarless extract is a thickish substance, of a very light brown color with a strongly salty taste reminiscent of certain cheeses and has a special smell. When completely dry it is a golden colored powder, very hygroscopic, insoluble in ether but easily dissolved in water as well as in hydroalcoholic solutions, diluted acids and saline.

The aqueous solution of the dry extract has no reducing action on Benedict's reagent and its alcohol ketonic extract does not precipitate with diligtonin, either directly or after saponification with potassium hydroxide. There was no demonstrable tryptic activity with Gross's method.

Ashes. By the usual method of calcination the average sample gave 17.3 grams of ashes for every 100 grams of dry extract.

Total nitrogen. In two average samples, the total nitrogen was assayed by Kjeldahl's method. By distillation with Goldberg and Banfi's apparatus (18) the resulting ammonia was collected in a measured volume of sulfuric acid of known normality and then valued by photocolometry with Nessler's reagent.

Results. Sample 1: 11.6 grams of total nitrogen for every 100 grams of dry extract. Sample 2: 10.02 grams of total nitrogen for every 100 grams of dry extract.

Average. 10.31 grams of total nitrogen for every 100 grams of dry extract.

These figures agree with those given by Dragstedt when using his own extract (7). According to him lipocaic prepared by means of his modified technique contains 12.5 grams of methionine and no choline (7).

TESTING THE PANCREATIC EXTRACT

The lipotropic action of the pancreatic extract was tested both as a preventive and corrective agent. This was done by administering it either immediately after ligating the pancreatic ducts (dogs 621, 661 and 681) or at intervals ranging between 38 and 161 days after the operation (dogs 503, 544, 526, 544).

The extract was given by the oral route (capsules) or systemically (subcutaneous injection of the extract dissolved in distilled water or sterile saline solutions).

The different preparations used in our experiments were:

Lipocaic: pancreatic extract prepared by us according to our modification of Dragstedt's method. One capsule contains the equivalent of 14.3 grams of fresh pancreas. For systemic administration an equivalent amount of dry extract was dissolved in 3 milliliters of distilled water or sterile saline.

Preparation. A pancreatic extract prepared as above at a laboratory of medicinal products. We are not familiar with its precise equivalent in terms of fresh pancreas, though we believe it is very close to that of our preparation.

centimeters beyond the lower duct. Only the larger blood vessels were left untouched. Finally pieces of omentum were placed between the pancreas and duodenum and were secured in position by cotton sutures. The abdominal wall was closed in 2 layers, cotton being used in both. Interrupted stitches were used for the fascia and subcuticular sutures for skin.

The dogs were given no food for 48 hours after operation. After this time feeding was started with meat bread milk and sugar. Plenty of water was allowed. This basic ration was used in all experiments. The pancreatic extract for testing was given to the animals in gelatin capsules which were later mixed in the meat. In some cases biopsies of liver tissue were made during the course of the experiment. Necropsy was performed in all animals in order to ascertain the degree of pancreatic atrophy and to remove samples of different organs for pathological study. These specimens were fixed in formalin and embedded in paraffin. The histological sections were colored with hematoxylin-eosin.

Chemical determinations in blood. For the purpose of studying the effect of the ligation of the pancreatic ducts on some of the blood components and the action of lipocain on them the following periodical determinations were carried out: blood sugar (Folin's method), cholesterol in serum (Schoenheimer and Sperry's method), phospholipid in serum (total phospholipids, Subbarow and Fliske's method adapted by Marenzi to a photometer), prothrombin concentration in plasma (Tanturi and Banfi's technique), serum proteins (by pyknometry after Moore and Van Slyke's indications) and alkaline phosphatase in serum (Shinowara, Jones and Reinhart's method). In the latter a modification in the assay of phosphates was introduced and Holman's method was used. In all animals blood was extracted during fasting. Every determination was done within 12 hours of obtaining the samples and only those samples of serum and plasma wholly exempt from hemolysis were used.

PREPARATION OF PANCREATIC EXTRACT WITH LIPOTROPIC ACTIVITY (LIPOCAIC)

Dragstedt's technique with certain modifications was employed for preparing the pancreatic extract (11).

Fresh pancreas from cattle were passed through a mincing machine and the mass was then left to macerate for 24 hours in twice its volume of 95 per cent alcohol, the mixture being shaken at intervals. Once the hydroalcoholic layer had been decanted, the residue was subjected to further extraction with 10 per cent alcohol for a second 24 hours. At the end of this period the extractive fluid was mixed with the former—which had been kept in cold storage—and the residue was macerated twice again. It was proved later that the fourth extraction was useless, so this fourth step has been discontinued.

Finally the residue was squeezed through gauze and all the extractive fluids were mixed and distilled at vacuum at a low temperature (maximum external 43° C. internal 35° C.) in order to recover the alcohol which could be used again in the second and third extractions.

As the alcoholic content of the extractive fluid decreases during the distillation process, the lipids are freed and appear on the surface in the shape of flocculi. These are easily removed by filtration. Thus Dragstedt's costly method of fat-extraction by means of ether is dispensed with. After we devised this method Dragstedt (7) modified his technique, eliminating either process of fat-extraction.

The watery fluid resulting from distillation contains the lipotropic principle. This fluid was filtered and concentrated by vacuum over sulfuric acid and at room temperature until a thickish substance was obtained. This substance was made into a homogeneous paste by adding 30 per cent of its weight of powdered sugar for preservation purposes, and mixing with a spatula. Later gelatin capsules were filled with this paste (approximately 0.75 gram per capsule) and were immediately placed in wide-mouthed glass containers with frosted glass stoppers. These containers were kept in an icebox to prevent the capsules from coming into contact with a humid atmosphere.

The product described is the one we used per se in our experiments. When testing its activity by the systemic route we used the powder obtained by drying the pure extract; no sugar was added and the powder was aseptically dissolved in sterile saline.

We were able to prove the absence of lipids in our preparation by extracting with ether in a Soxhlet apparatus; the powder obtained by total drying of the sugarless extract—the residue thus found, is practically negligible. It was this powder that we extracted with ether which we used in some physical and chemical determinations.

Yield. The yield can be calculated in terms of dry extract, fluid extract or extract with sugar.

Five kilograms of fresh pancreas gives an average of 300 grams of fluid extract, that is, the equivalent to a 4 per cent yield.

As the fluid extract contains 30 per cent of water the 5 kilograms of fresh pancreas are equivalent to 240 grams of dry powder (Dragstedt's lipocain), which means that the yield in dry powder is of 2.4 per cent.

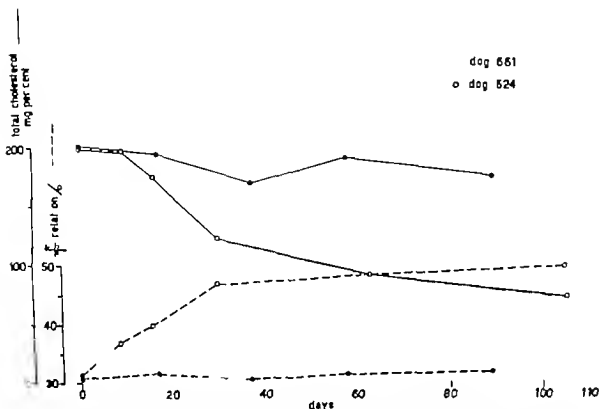


Chart 3. Decrease of total cholesterol and relative increase of free cholesterol in the untreated animals. This is expressed by the free to total cholesterol relation the value of which remains fairly constant under normal conditions (39.8 to 31.5%) and in the dogs treated with lipocaic (dog 661)

59.7 per cent also after 106 days in dog 524 and 109 per cent after 161 days in dog 544

The decrease of phospholipids—sometimes preceded by a slight increase (dogs 501 and 526)—was more or less slow yet constant and always parallel to that of cholesterol (Chart 3). After 51 days the value of this fall was equivalent to the 28 per cent of the initial value in dog 501 after 56 days to 55.3 per cent in dog 503 after 106 days of 48.5 per cent in dog 526 after the same number of days of 55 per cent in dog 524 and after 161 days of 58.4 per cent in dog 544.

The fall of prothrombinemia was an early feature and parallel to the aforesaid blood constituents. In dog 544 this decrease reached the figure of 65.2 per cent of the initial value on the 20th day after operation and in dogs 524 and 526 of 38.7 and 56.8 per cent respectively on the 106th day.

The increase of the alkaline phosphatase activity of serum also appeared early and it rose during the course of time up to figures 22 times higher than the initial value (dog 501)

Preventive action of the pancreatic extract

Different doses of the extract prepared according to our technique were studied in dogs 661 and 581 with the view of studying its capacity for preventing the appearance of the aforementioned blood changes. Capsules were administered to dogs as soon as appetite reappeared viz. on the 2d and 3d days after duct ligation. Daily doses equivalent to 75 grams of fresh pancreas (5 capsules) proved capable of maintaining within normal limits during 3 months the animal's weight, cholesterolemia free to total cholesterol relation and lipidic phosphorus but not prothrombinemia. The latter though never reaching hemorrhagic levels always showed itself irregularly variable.

An interesting feature was observed in the case of phosphatase: it rose during the first days but it began to fall after the 17th day to return to normal on the 58th day. This evolution should be compared to that of untreated dogs in which increase of phosphatase activity is a constant feature (Chart 1)

X preparation. an aqueous solution of a pancreatic extract, for intramuscular injection, manufactured by a firm of medicinal products. According to the makers, each ampul contains 200 milligrams of active substance (5 ml.) and 0.3 per cent of phenol. Its equivalent in terms of fresh pancreas is unknown.

Z preparation. pancreatic autolysate in aqueous solution for intramuscular injection. Also a commercial preparation. Its nitrogen content is not known.

Casein hydrolysate. Prepared after the method of White and Elman (37) by boiling during 6 hours in 2.6 normal sulfuric acid and then precipitating the acid surplus with barium hydroxide. The solution of amino acids, to which 5 per cent glucose was added, was divided and put in sterilized tubes and rendered aseptic by tyndallization. According to Kjeldahl's method 20 milliliters of this solution contain 267 milligrams of total nitrogen. The slow intravenous injection of this preparation caused no intolerance or anaphylaxis in dogs.

RESULTS AND COMMENTS¹

No trouble was ever experienced in feeding or administering the lipocatic capsules in the postoperative stage as the animals always had good appetites. However all of the dogs lost weight during the experimental period. Their stools were of normal appearance at first but after 2 to 3 weeks they became bulky, thickish, of grayish color rich in fats and of offensive smell in some cases associated with gastric and duodenal ulcers blood was detected (dogs 501 and 544). In spite of the loss in weight the animals were always active never having shown signs of apathy or asthenia. Their coats and fur were covered by a greasy secretion.

Under the experimental conditions stated, ligation of the pancreatic ducts in the dog brought about a loss in weight and various organic and metabolic disorders. These results were demonstrated by quantitative changes in the concentration of certain blood constituents and by fatty infiltration of the liver. The blood imbalance became manifest through (a) a drop of serum proteins (b) decrease of the total plasma cholesterol together with a relative rise of free cholesterol (or a fall of ester cholesterol) (c) decrease of the plasma phospholipids (d) drop in plasma prothrombin (e) increase of the alkaline phosphatase activity of serum.

Due to lack of space, the protocols of each individual dog have been omitted.

The loss in weight was notable within a few days after the operation and became more pronounced during the days in which no lipocatic was administered. This weight loss cannot be due to anorexia as the animals were provided with abundant rations and had excellent appetite. It is caused more likely by a disorder of the fat and protein absorptions brought about by the absence of pancreatic enzymes in the intestine. This condition is partly shown by the increase in volume and frequency of stools very rich in fats.

A fall in serum proteins became evident between the 28th and 37th days after the operation (dogs 621, 661 and 681) and can be considered as an indication of absence of the pancreatic proteolytic enzymes in the intestine. As time passed, the hypoproteinemia became more marked, except in those cases in which the casein hydrolysate was injected (dog 671).

A decrease of total cholesterol—sometimes preceded by a slight increase (dogs 501 and 526)—was seen in all cases and became more accentuated in the course of time. It was already apparent on the 17th or 28th day after operation, but the intensity and speed of development of this symptom varied. The decrease value was 58.3 per cent on the 51st day in dog 501, 64.3 per cent on the 56th in dog 503, 65.7 per cent on the 106th day in dog 524, 46.3 per cent also in the 106th day in dog 526 and 68.9 per cent on the 161st day in dog 544.

Parallel to this decrease of total cholesterol there was a relative increase of free cholesterol (Chart 2) this is shown in the relation $\frac{\text{Free cholesterol}}{\text{Total cholesterol}}$ the value of which—according

to our experiments—remains fairly constant under normal conditions (29.8–31.5%).¹

This index underwent more modifications as time passed even when there was a decrease of the total concentrations of total and free cholesterol. The quantitative variations differed according to the animals. After 51 days, it was 62.3 per cent of the initial value in dog 501, 71.5 per cent after 56 days in dog 503, 52.4 per cent after 106 days in dog 526.

¹F/T% means the percentage of free cholesterol. Its reference to total cholesterol.

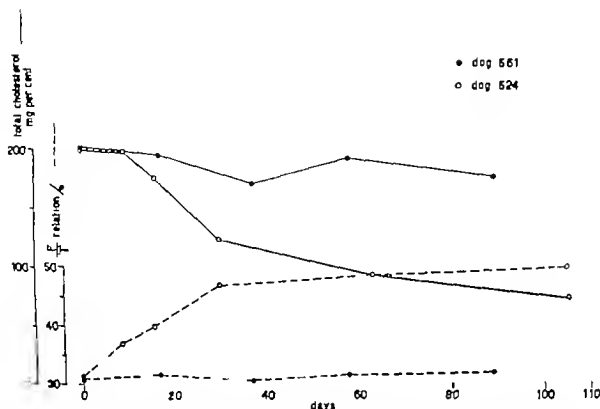


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A fall in serum proteins became evident between the 28th and 37th days after the operation (dogs 621 661 and 681) and can be considered as an indication of absence of the pancreatic proteolytic enzymes in the intestine. As time passed, the hypoproteinemia became more marked, except in those cases in which the casein hydrolysate was injected (dog 671).

A decrease of total cholesterol—sometimes preceded by a slight increase (dogs 501 and 526)—was seen in all cases and became more accentuated in the course of time. It was already apparent on the 17th or 28th day after operation but the intensity and speed of development of this symptom varied. The decrease value was 58.3 per cent on the 51st day in dog 501 64.3 per cent on the 56th in dog 503 65.7 per cent on the 106th day in dog 524 46.3 per cent also in the 106th day in dog 526 and 68.9 per cent on the 161st day in dog 544.

Parallel to this decrease of total cholesterol there was a relative increase of free cholesterol (Chart 2) this is shown in the relation Free cholesterol the value of which—according to our experiments—remains fairly constant under normal conditions (29.8–31.5%).

This index underwent more modifications as time passed even when there was a decrease of the total concentrations of total and free cholesterol. The quantitative variations differed according to the animals after 51 days it was 62.3 per cent of the initial value in dog 501 71.5 per cent after 56 days in dog 503 52.4 per cent after 106 days in dog 526

FF/T% means the percentage of free cholesterol with reference to total cholesterol.

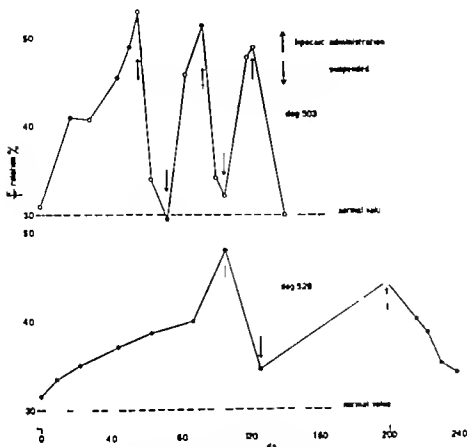


Chart 4. The increase of the free to total cholesterol relation is prevented or corrected by the administration of lipocaic.

As time passes the response to the oral administration of pancreatic extract becomes both less regular and not so marked (Chart 4). Though there is an improvement in spite of longer treatment the complete recuperation to preoperative levels is never achieved.

Shortage of material prevented us from pursuing these tests for very long periods; however, we suggest the possibility that more prolonged treatment or larger doses may bring about complete corrective action. With reference to the latter, it is worth mentioning that at the end of 8 days the daily administration of 10 capsules of our extract (equivalent to 150 grams of fresh pancreas) failed to exceed the absolute increase of blood cholesterol and lipoidic phosphorus obtained with 5 capsules daily; nevertheless, they improved the free to total cholesterol relation beyond all comparison, notwithstanding the fact that the administration was begun 193 days after duct ligation.

The study of the corrective action of lipocaic on blood hyperphosphatemia (dogs 621

671 and 681) shows that together with cholesterolemia and phospholipemia hyperphosphatemia undergoes a marked decrease with the administration of adequate doses of our preparation.

The corrective action of the γ preparation on the blood changes was tested on dog 524. The administration was started 107 days after operation and although employing doses similar to those of our preparation it proved to be much less active. This striking occurrence with a substance manufactured by the same process as ours was the result we believe of faulty technique. We learned that the temperature to which the extractive fluids was submitted during the concentration process was not controlled, thus the lessened activity due to the thermolabile character of the lipotropic principle of the pancreas (14, 27).

Tests by systemic administration. Injected into dog 526 at the moment when biopsy of liver tissue revealed a large degree of fatty infiltration (Figs 3 and 4) and an abnormal

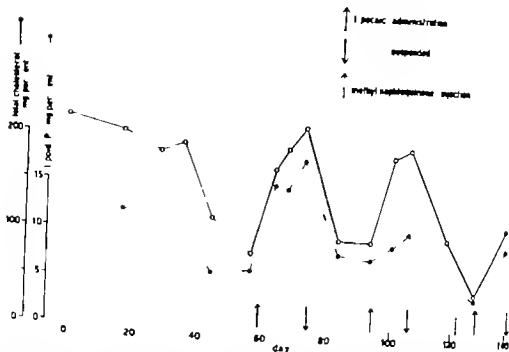


Chart 3. The decrease of phospholipids also parallels that of cholesterol. The daily administration of 5 capsules of *Lipocae* produces an increase of total cholesterol and phospholipids. The modifications are unquestionably due to the effect of pancreatic extract administration, because figures show that as soon as it is stopped, the blood changes recur moreover they again disappear when treatment is started anew.

A dose of less than 5 capsules was incapable of maintaining a normal blood picture (dog 68x). A subsequent increase to 5 capsules daily restored altered values to normal with the exception of blood proteins and prothrombin phosphatase did not return to its initial value yet decreased to figures close to it.

The administration of 5 capsules daily of the *Y* preparation proved to be more efficient than 3 of our extract daily yet less so than 5 of the latter as shown by the free to total cholesterol relation.

Corrective action of the pancreatic extract. Experiments were also carried out to see whether the extract was capable of correcting the dysfunctions caused by ligation of the pancreatic ducts. This experiment was done by administering the substance 58 112 and 161 days after the operation (dogs 503 562 and 544 respectively) when the values of cholesterol, phosphorus and prothrombin in blood were low and the free to total cholesterol relation increased in the aforesaid proportion.

The daily administration of 5 capsules of our preparation brought about an increase of the total cholesterol phospholipids, and prothrombin together with a decrease of the free to total cholesterol relation. When the administration was started on the 60th day after operation the preoperative levels were exceeded on the 13th day after the treatment was commenced yet if the administration of the extract was begun 113 and 132 days after surgical interference this rise did not take place until after 13 and 20 days, respectively after the administration was started. Prothrombin behavior was irregular dog 524 in which treatment was started latest of all—showed greater increase than that which appeared in dog 526.

The modifications are unquestionably due to the effect of pancreatic extract administration because figures show that as soon as the extract is stopped, the blood changes recur moreover they again disappear when administration of the extract is started anew (Chart 3).

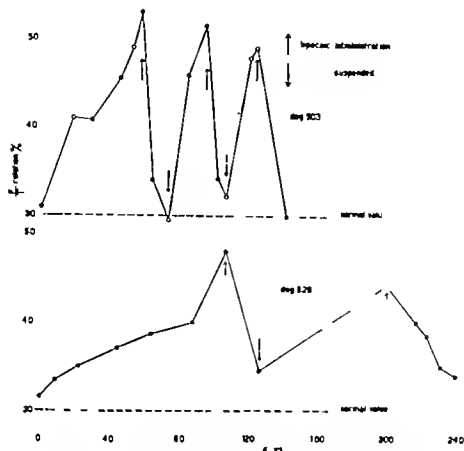


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As time passes the response to the oral administration of pancreatic extract becomes both less regular and not so marked (Chart 4). Though there is an improvement in spite of longer treatment the complete recuperation to preoperative levels is never achieved.

Shortage of material prevented us from pursuing these tests for very long periods; however we suggest the possibility that more prolonged treatment or larger doses may bring about complete corrective action. With reference to the latter it is worth mentioning that at the end of 8 days the daily administration of 10 capsules of our extract (equivalent to 150 grams of fresh pancreas) failed to exceed the absolute increase of blood cholesterol and lipoidic phosphorus obtained with 5 capsules daily; nevertheless they improved the free to total cholesterol relation beyond all comparison notwithstanding the fact that the administration was begun 193 days after duct ligation.

The study of the corrective action of lipocaic on blood hyperphosphatemia (dogs 621

671 and 681) shows that together with cholesterolemia and phospholipemia, hyperphosphatemia undergoes a marked decrease with the administration of adequate doses of our preparation.

The corrective action of the Y preparation on the blood changes was tested on dog 524. The administration was started 107 days after operation and although employing doses similar to those of our preparation it proved to be much less active. This striking occurrence with a substance manufactured by the same process as ours was the result we believe of faulty technique. We learned that the temperature to which the extractive fluids was submitted during the concentration process was not controlled; thus the lessened activity due to the thermolabile character of the lipotropic principle of the pancreas (14, 27).

Tests by systemic administration. Injected into dog 526 at the moment when biopsy of liver tissue revealed a large degree of fatty infiltration (Figs. 3 and 4) and an abnormal



Fig. 1.

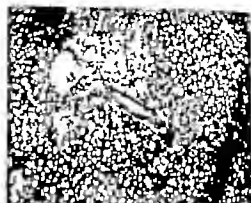


Fig. 2.



Fig. 3.



Fig. 4.

Figs. 1 and 2. Dog 503. Massive fatty infiltration of the liver. The cells of the trabeculae are deformed and round shaped owing to the presence of fat. Now and then a or 3 liver cells of normal appearance can be seen. There is no reaction of the connective framework. Free to total cholesterol relation, over 5 per cent.

Figs. 3 and 4. Dog 526. Liver biopsy performed on the

30th day of experiment and after 67 days without treatment. Marked fatty infiltration in the central trabeculae though less than in dog 503. With more powerful lens, the central cells appear affected by cytoplasmatic contraction; the nuclei remaining unchanged; others had undergone vacuolation and karyolysis (necrobiosis fat pancreas).

blood picture (310th day) our extract brought about a rapid increase of total cholesterol—together with an improved free to total cholesterol relation—and phospholipids but had no effect on prothrombinemia. Taking into account the short treatment (3 days) and the time since the ducts had been ligated the response can well be considered as quantitatively higher than that given by an equivalent dose per os.

The Y preparation tested on dog 524 also proved more active parenterally than by mouth.

We believe that the lesser efficacy of oral administration is due to a partial loss of the lipotropic principle in the intestine caused by both the anomalous absorption and acceler-

ated intestinal transit seen in dogs with ligated pancreatic ducts.

We shall now discuss tests with two other preparations administered systemically which we shall call X and Z.

One milliliter daily of preparation Z given subcutaneously to dog 621 during a fortnight, gave rise to an insignificant increase of total cholesterol together with a higher free to total cholesterol relation and a decrease of phospholipemia; only prothrombin showed a significant improvement.

The daily subcutaneous injection of 4 milliliters of preparation X—started 13 days after oral administration with our extract when cholesterol free to total cholesterol relation and phospholipids in blood had become nor-



Fig. 5



Fig. 6



Fig. 7

Fig. 5. Dog 544. Liver with perlobular fatty infiltration. The structure of the remaining cells of the lobule is totally unaffected. Free to total cholesterol relation 52 per cent.

Fig. 6. Dog 524. Liver biopsy obtained after 30 days treatment with systemic injection of lipocaic (30th day of experiment).

The hepatic structure is preserved; there is only a slight fatty infiltration of the peripheral cells of the lobules.

Normal connective tissue. Free to total cholesterol relation 37 per cent.

Fig. 7. Dog 524. Appearance of the liver at the end of experiment. The fatty infiltration is somewhat more pronounced than in Figure 6 and always of perlobular localization. Under a more powerful lens, the liver cells are seen with a normal nucleus and cloudy cytoplasm. Slight polymorphonuclear infiltration between the trabeculae. No cell necrosis. Free to total cholesterol relation, 41.5 per cent.

mal—caused these values to drop to abnormal levels at the end of 29 days of treatment with an increase of blood phosphatase and maintenance of hypoproteinememia.

In view of the fact that subsequent administration of our extract corrected the altered values, those results can be attributed to the small activity (or total lack of it) of the preparations X and Z at least in the doses used by us.

Complementary tests. The decrease of serum proteins in all dogs with ligated pancreatic ducts led us to investigate the possible relation between the hypoproteinememia and the other blood changes observed in these animals. Therefore we used daily doses of casein hydrolysate intravenously in amounts equivalent to 267 milligrams of nitrogen. The injection of the hydrolysate alone (dog 621) or as a complement to the oral administration of insufficient doses of our extract (dog 671) or of preparation Y (dog 621) always gave rise to an increase of proteinemia—which in some cases returned to normal—and of protrom-

bin. At the same time there was an adverse effect on the remaining blood components as the cholesterol and lipoidic phosphorus figures dropped while the free to total cholesterol relation and phosphatase activity rose.

Relation between fatty infiltration of the liver and blood changes occurring in dogs with ligated pancreatic ducts. Former papers by Chaikoff, Dragstedt, Rall, and others (4, 10, 12, 16, 17, 29) have shown the intimate relation existing between the fatty infiltration of the liver of dogs without pancreas or with ligated ducts and the variations of cholesterolemia, the cholesterol esters and lipoidic phosphorus to which we add those of blood phosphatase and protrombin.

The following experimental facts prove that our pancreatic extract possesses lipotropic activity:

a. **The absence of fatty infiltration** was noted in the liver of dog 661 (Fig. 8) that received daily doses equivalent to 75 grams of fresh pancreas immediately after having had its pancreatic ducts ligated.

This result cannot be attributed to faulty operative technique as at necropsy complete atrophy of the pancreas was found. Neither can the presence of a few Langerhans islands on the covering omentum be considered as a cause as the same thing was observed in every animal moreover a direct histological control was kept on dog 526 and an indirect one through the absence of diabetes in all animals. Only dog 550 showed a macroscopically identifiable pancreas (although somewhat smaller in size) but in this dog the accessory duct was found patent thus explaining the lack of blood and liver changes.

b The presence of fatty liver (diagnosed macroscopically) in untreated dog 501. The short time which elapsed between ligation of duct and the appearance of this lesion (51 days at the most) shows this case to be an early one, as Chaikoff and associates (24) say that in their experiments the minimum lapse of time was 12 weeks.

Comparing the blood picture of these two opposite experimental conditions (dogs 661 and 501) with that belonging to the dogs subjected to different treatment and studying them with their respective microscopic pictures it is easy to conclude that both the fatty deposit in the liver of dogs with ligated ducts and its mobilization by means of lipocaine can be followed through the variations of total cholesterol free to total cholesterol relation phospholipids and phosphataseemia. However from the quantitative viewpoint this interrelation is so variable in the different animals that we were unable to establish the minimum effective dose of lipocaine.

Free cholesterol and free to total cholesterol relation Dogs with ligated pancreatic ducts show total hypocholesterolemia together with a rise in the relative concentration of free cholesterol (or as some authors describe it a decrease of the cholesterol esters) as shown by an increase of the free to total cholesterol relation. Already described by other investigators (10-29)

We were able to prevent or correct this alteration by the daily administration in doses of 75 grams of our extract of fresh pancreas given both by mouth and systemically

Broadly speaking both indexes have a parallel evolution under the influence of the derivatives of lipotropic treatment, although the quantitative response is inversely related to the time elapsed between the ligation of the ducts and the beginning of treatment. This would seem to suggest that, as time passes, the liver injury caused by the operation, becomes progressively refractory to the lipotropic action of the extract.

However if we compare the histological pictures of our dogs' livers with the free to total cholesterol relation, it seems possible to establish a gross analogy between the value of the latter and the different degrees of fatty infiltration. In fact the progression of the fatty infiltration shown in the photomicrographs is parallel to the increase of the corresponding values of the free to total cholesterol relation, to wit

Fatty infiltration.

Photomicrographs No 1>3=5>7>6

F/T relation % +51>52.5=52.4>41.5>37

Therefore in these dogs a free to total cholesterol relation equal to or higher than 50 per cent can be taken as an index of an intense fatty infiltration of the liver.

The positive response to the lipocaine's lipotropic action has been pointed out as characteristic of fatty livers rich in cholesterol (22). As McHenry suggested such an anti-fatty liver factor may be somehow related—in a manner as yet unknown—with the cholesterol metabolism.

It is also possible that the return to normal of the free to total cholesterol relation may be due to the hepatocyte having regained its capacity to esterize free cholesterol which had been affected during the process of fatty infiltration. Thannhauser and Shaber say that the fall of the cholesterol esters (*Esteremia*) seen in cases of liver injury is caused by an alteration in the liver cell's capacity to esterize free cholesterol with fatty acids. However Gardner and Gainsborough, Bürger and Hahn, and other investigators have challenged the idea of considering the liver as the specific and indispensable center of cholesterol esterification in view of the fact that this function is still present even increased—in hepatomized $\frac{1}{2}$ (30)

Phospholipids As stated before after the pancreatic ducts are ligated there is a fall in the blood content of phospholipids parallel to that of cholesterol however these figures rise and even become normal after lipocaic administration. This fall has also been reported by Chaikoff (4 5 16) in depancreatized dogs treated with insulin or in others with ligated pancreatic ducts it was considered as an index of a decrease of the plasma choline because the latter is found entirely combined as phospholipid (31 32).

According to this author (5) the decrease in circulating choline is not due to its absence in the diet but to a lack of the lipotropic factor of the pancreas which has an enzymatic character and therefore acts through setting free the methionine present in the food proteins. Once absorbed methionine is transformed in to choline i.e. the real lipotropic agent.

The relation existing between choline and methionine has been indisputably proved by du Vigneaud (13 33) in the rat rabbit and man and by McKibbin in the dog. These authors showed that choline arises from methionine thanks to the labile methyls of the latter's molecule. The administration of pancreatic extract—source of Chaikoff's enzymatic factor—would allow the methionine of foods to be used as lipotropic agent with the resulting choline synthesis and increase of plasmatic phospholipids.

Our results although confirming Chaikoff's in the matter of the phospholipemia variations brought about by providing or withdrawing administration of pancreatic extract to dogs with ligated pancreatic ducts do not agree with his theory of the rôle of methionine in this process. This was shown by the fact that the injection of casein hydrolysate had no lipotropic effect as witnessed by the values of cholesterol phospholipids and prothrombin in blood. This statement of ours is made with reservations as we were unable to assay quantitatively the methionine present in the hydrolysate.

Alkaline phosphatase After the pancreatic ducts had been ligated phosphatasemia increased in every animal. Bearing in mind that the rise of alkaline phosphatase activity of blood has been taken as a sensitive index



Fig. 8 Dog 661. No fatty infiltration. Slight granular disintegration of the liver cells with nucleus of normal appearance. Free to total cholesterol relation .33 per cent.

of functional or minimal biliary obstruction (3) it is possible to understand the marked and progressive hyperphosphatasemia in both dogs not having received lipocaic (dog 501) and in those in which the changes in the blood values of cholesterol and phospholipids pointed to the presence of a fatty infiltration of the liver.

In fact the fatty accumulation in the liver can be considered as equivalent to a moderate biliary obstruction which would explain the rise of phosphatasemia to levels lower than those seen in total obstruction yet higher than the ones found in hepatosis (3). This statement is further supported by the fact that lipocaic treatment decreases hyperphosphatasemia, but not always improves prothrombin figures. The latter occurrence speaks more in favor of a liver cell injury.

According to our observations on cholecystectomized dogs (3) the meaning of the initial hyperphosphatasemia seen in dog 561 is of different origin. The absence of fatty infiltration in this animal's liver suggests that in this case the transitory increase of blood phosphatase is due to a slight functional biliary obstruction caused by surgical interference. If it is remembered that the accessory pancreatic duct opens into the duodenum at the very level at which the common bile duct be-



Fig. 9.

Fig. 9. Dog 67. Appearance of the liver after 5 days treatment with adequate doses of lipocac. N fatty infiltration. Hepatocytes are slightly round-shaped and swollen. Normal nucleus and cloudy cytoplasm in the process of disintegration (albuminoid degeneration). Some small necrotic foci in which the nucleus of cells has disappeared. Free to total cholesterol relation, 33.4 per cent.

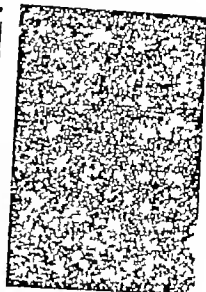


Fig. 10.

Fig. 10. Dog 550. Normal appearance of the liver. Necropsy of this animal showed the persistence of the pancreatic duct accessory. Free to total cholesterol relation, 20 per cent.

comes intraparietal, this operative trauma will explain why there is a return to normal of phosphatasemia after 50 days just as in cases of cholecystectomized dogs. This effect should also be present in untreated dogs but when the time comes for it to disappear this does not take place owing to the fatty infiltration of the liver.

If our conception of the problem is correct the return to normal of phosphatasemia is a more accurate index for revealing the disappearance of the fatty infiltration of the liver under the action of lipotropic preparations than that of cholesterolemia, free to total cholesterol relation and phospholipemia. The disappearance of the infiltration should take place at least 50 days after the duct ligation. This fact agrees with the observation that phosphatase activity does not entirely return to the initial level at the time when the other blood components have become normal under the effect of the administration of our extract (dog 544, 51st day).

We believe that the persistence of a marked hyperphosphatasemia in dogs with pancreatic

ducts ligated more than 50 days before must be considered as an additional index of fatty infiltration of the liver.

Prothrombin. Our results show that in the dog the ligation of the pancreatic duct causes a liver injury revealed by a fall in the prothrombin concentration of the blood. This decrease cannot be attributed to a lack of vitamin K intake as treatment with 2-methyl-1-4 naphthoquinone did not improve the hypoprothrombinemia in accordance with the doses given. Instead the subsequent administration of lipocac proved to be far more effective.

The effect on hypoprothrombinemia of pancreatic extract administration became more evident in the treatment of early cases, but only in 2 of the 9 dogs we studied was it found possible to increase it to normal figures. In the 7 others, the response was either variable or never reached the subnormal concentrations, even though there was a return to normal of hypocholesterolemia and phospholipemia.

The persistence of hypoprothrombinemia after the normalization of the other blood

changes following the administration of the lipotropic extract and the shortlived initial fall in the prothrombin of dogs without fatty liver (dogs 661 and 550) seems to indicate that the variation of this blood principle is due not only to the presence or lack of fatty infiltration of the liver, but to some other cell injury that lipocaic does not repair altogether. Former experiments of ours (3) showing prothrombinemia as a more sensitive test for detecting the functional alteration of hepatocytes undoubtedly support this assertion.

Prothrombin increase after an injection of casein hydrolysate (dogs 621 and 671) appears to suggest the existence of a certain relationship between the hypoprothrombinemia and the protein deficit; however, further research is required on this point.

Proteins We have already remarked that the variations and response of proteinemia toward lipocaic administration are independent of those of the other blood components and vice versa.

The use of pancreatic extract as a corrective and preventive measure caused serum proteins to decrease both in animals treated early and in those untreated; moreover this decrease was unaffected by lipocaic administration. These results suggest that hypoproteinemia probably has its origin in deficiencies in protein digestion in the intestine brought about by ligation of the pancreatic ducts. In our experiments the results of investigations with casein hydrolysates dismiss the possibility of hypoproteinemia as a source of fatty infiltration of the liver. Evidently in dogs with ligated pancreatic ducts proteinemia and its regulating factors have no influence on the disorders of lipid metabolism and their repercussion on liver function.

With reference to the apparent potentiation of fatty infiltration of the liver by injections of casein hydrolysate, amino acid mixtures and glucose we cannot offer any plausible explanation. We believe that more purified preparations should be used in order to exclude the possibility of a toxic action by foreign substances.

Liver changes brought about in the dog by ligation of the pancreatic excretory ducts Macroscopical and microscopical examinations of

the liver show that in the dog ligation gives rise to a pathological fatty infiltration of said organ. Is this lesion an exaggeration of normal processes? It does not seem to be so as the said infiltration produces blood changes which reveal a considerable degree of liver injury.

Lipocaic administration corrects the liver infiltration provided treatment is started early; the later it is begun, the less pronounced is the improvement, thus a certain degree of liver injury remains.

A study of histological sections of the livers indicated that the functional disorder resembles that of a lesion with all the appearances of the reversible type. In the treatment of later cases, the impression remains that under more prolonged administration of the extract the function of the liver eventually becomes normal. With reference to this one should bear in mind the higher lipotropic efficacy of duplicating the effective minimum dose (dog 554 193rd day) and of systemic administration.

A point worth stressing is the presence of a type of lesion (Fig. 9) in which the cytoplasm of the hepatocyte appears cloudy and disintegrating (albuminoid degeneration); there are also some necrotic foci and karyolysis. From the pathological viewpoint albuminoid degeneration is considered as an alteration of the cell's proteic contents and it is often associated with a degenerative fatty infiltration (38). In this case (dog 671) such a lesion would explain the persistence of hypoprothrombinemia after the return to normal of cholesterolemia, free to total cholesterol relation and phospholipemia, following the administration of pancreatic extract.

We are unable to tell to what extent the pursuance of treatment will influence the return to normal of altered liver function and cell architecture. This subject requires further study.

Glycemia behavior We have purposely left the subject of glycemia to the end of our discussion as it is our opinion that glycemia is not influenced by the fatty infiltration process. In dogs in which the pancreatic ducts have been ligated, in all cases blood sugar remained within normal limits until the end of the ex-

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PATELLECTOMY

A Simplified Technique

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THE increasing popularity of patellectomy together with the recognition of more frequent indications for the operation justifies the report of a simplified technique.

The general indication for patellectomy is a condition of the patella which impairs function of the knee joint or produces continued trauma to the joint surface and is painful. Patellectomy has been recommended for the following conditions: severe hypertrophic arthritis, traumatic arthritis, chondromalacia, osteochondritis dissecans, degenerative chondritis and old malunited fractures of the patella.

The technique to be described is not applicable in acute fractures or in old fractures of the patella which have not been repaired. The decision to remove the patella should be made before the operation as a capsular incision precludes use of this method. Sir Robert Jones was largely responsible for the split

patellar approach to the knee joint. This bisection of the patella is not recommended except when it is to be followed by excision.

Approach may be made either through a transverse or an anteromedial parapatellar incision. The skin and subcutaneous tissues are reflected thus exposing that portion of the extensor mechanism covering the anterior surface of the patella. The quadriceps expansion overlying the patella is then incised longitudinally in the midline. The incision is prolonged into the patellar and quadriceps tendons for the distance of 1 centimeter. The knee is flexed slightly and maintained in this position. The patella is grasped with towel clips on its medial and lateral sides in order to steady it while the operator sections it longitudinally with a saw (Fig. 1).

Care is taken to avoid introducing bone dust into the knee joint by careful cleansing of the wound just prior to completion of the patellar section. The patella is then elevated with the

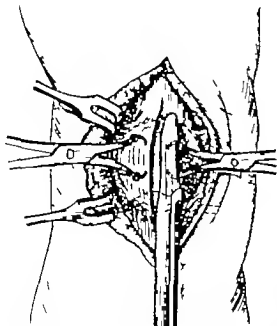


Fig. 1. Anterior surface of patella has been exposed and the bone is being divided with a saw.

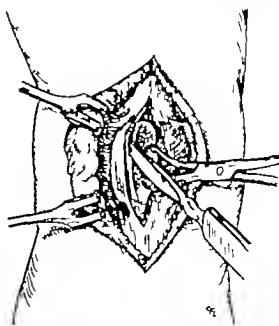


Fig. 2. Half of the patella is being enucleated from the extensor mechanism.

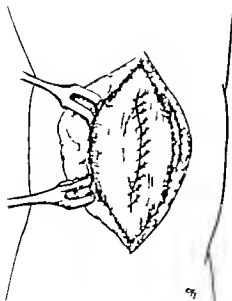


Fig. 3. The defect in quadriceps mechanism has been closed by plication.

towel clips in order to avoid traumatizing the cartilaginous surface of the femoral intercondylar notch as the section is completed with the saw or an osteotome.

One half of the patella is then grasped with a towel clip and positioned in such manner that the quadriceps expansion can be separated from the anterior surface of the patella by sharp dissection (Fig. 2). The other half is removed in like manner.

The anterior compartment of the knee joint can now be visualized for exploration or any additional surgery that may be indicated.

In closure of the extensor apparatus the edges may be simply approximated or imbricated with interrupted nonabsorbable sutures

of cotton or silk (Fig. 3). The remainder of the wound is closed in layers in the usual manner.

In methods of patellectomy which require a transverse closure of the extensor mechanism there is marked tension on the suture line making early active contraction of the quadriceps and flexion of the knee joint hazardous. The technique of patellectomy described does not produce a defect in the extensor apparatus or divide the capsule on either side of the patella. There is minimal tension on the suture line during active extension or flexion of the knee which permits immediate quadriceps setting exercises and early active motion at the knee joint.

COMMENTS

1. A simplified technique for patellectomy is described. This method has been employed in 10 cases.

2. The expansion of the quadriceps mechanism and capsule of the knee joint are not damaged.

3. Shortening of the quadriceps is not produced.

4. The defect in the quadriceps mechanism is minimal and can be closed in longitudinal direction.

5. Immediate postoperative quadriceps setting exercises and early active motion may be instituted without jeopardy to the suture line.

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PROGNOSIS IN CARCINOMA OF THE BOWEL

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THE desirability of doing end-to-end anastomosis when resecting carcinoma of the colon or rectum is now one of the standard topics for discussion at surgical meetings. This paper will summarize some of our findings and may help you decide the proper procedure for each case.

Nine years ago we reported a method for the examination of surgically removed specimens of carcinoma of the colon and rectum.¹ By this method the specimens are made transparent, so that lymph nodes as small as one-half low power microscopic field ($\times 100$) can be identified easily. Full scale drawings of the specimens were made with accurate location of all of the lymph nodes. Microscopic sections of each node were made. We have studied about 325 specimens in this way and over 15,000 different nodes have been sectioned. The findings were similar in the entire series but this report will deal with the study of 200 of these patients who were operated upon 11 to 5½ years ago. Over 10,000 lymph nodes were sectioned in these 200 specimens.

Carcinoma spreads by direct extension by the blood stream and through the lymph system. If the spread by direct extension is great, the tumor is apt to be fixed to other structures. In the colon and especially in the sigmoid such fixation is often due to inflammation the tumor having extended much less than is at first imagined. This fact has justified the resection of contiguous organs. Spread by the blood stream seems to occur in 10 per cent to 15 per cent of operable cases as shown by Collier.

A study of our material has led to the conclusion that the lymphatic spread of carcinoma is primarily embolic, and that the nodes where cancer emboli lodge prevent further spread until the node is completely overwhelmed by carcinoma. Further embolic

spread is through the collateral lymph channels each new node involved tending to make a longer channel for a new embolus to travel. Spread from one node to another does not seem to be common at least during the period when lesions are seemingly operable.

It is possible to reproduce this picture of spread through the lymph system experimentally.² It is not difficult to insert a 27 gauge needle directly into the afferent lymph channels in a dog's mesentery. Similar injections can be made into lymph channels in a rabbit's ear or into lymph channels in the skin. We have made injections directly into as many as 14 different afferent lymph channels entering one node in a dog's mesentery. Many large afferent lymph channels break up into 2, 3 or more short channels just outside of the node and then these short channels pierce the capsule to empty into different parts of the subcapsular space or one of the short channels may empty into the lymph sinus of an adjoining node. In addition there are usually several different anastomosing channels between the large afferent channels draining a given region of the bowel and the channels draining into adjacent nodes on either side.

When a colored solution is injected into an afferent lymph channel of a dog's or rabbit's mesentery using very low pressure the solution will penetrate through the node without coloring all of it. The node seems to be divided grossly into separate anatomic units so that material from a given channel seems to drain to a limited part of the node. When pressure is used in the injection the entire node will be colored before any dye appears in the efferent channel. If instead of a colored solution a suspension of carbon particles $\frac{1}{2}$ to 1μ in diameter or of silica which is less than $\frac{1}{2} \mu$ in diameter or a suspension of barium or carmine particles is used to inject into the afferent channel using very low pressure a different picture is seen. The suspension of colored particles will partially fill its own com-

From the Presbyterian Hospital and the College of Medicine of the University of Illinois. Funds for this study were supported in part by the Otto A. Sprague Foundation.

partment in the subcapsular space (Fig. 1 A). If more pressure is used the suspension will either overflow into the remainder of the node or it will enter the adjacent parts of the node through one of the short channels leading into a different part of the subcapsular space (Fig. 1 B). If there is much pressure the node is soon a solid black and the suspension may pass into one or even two or three of the adjoining nodes through the short channels (Fig. 1 C). At the same time it may back up one of the tributary channels emptying into the original channel injected and it is often possible to get it to go through a retrograde anastomosing channel and come through another afferent channel into an adjoining normal node (Fig. 1 D). Even great pressure to the point of rupturing the walls of the afferent channels will not force any one of the fine suspensions through the node. If the animal is killed immediately or is allowed to live for a week and then killed no sign of passage through any node is seen, either in transparent preparations or in microscopic sections. This experiment shows very graphically how when a node is destroyed or blocked the lymph drainage is rerouted through collateral channels or by retrograde means into a channel draining into a normal node. Carcinoma cells are many μ in diameter in contrast to these particles which were all less than 1μ in diameter. The normal system of collateral lymph channels plus the demonstration of retrograde channels available when nodes are blocked shows how much more likely spread of the large carcinoma cells is apt to be by collateral channels than by growth through lymph nodes.

A study of our surgical material has brought out the following facts:

1. Permeation of carcinoma through lymph channels was seen only when the lymph node central to the channel involved was already blocked with carcinoma.

2. Carcinoma metastases do not completely destroy the function of a node until all of the node is destroyed. This was shown in a surgical specimen of carcinoma of the breast. The lymph channels in the neighborhood of the tumor were injected with a suspension of carbon particles. The specimen was cleared and some of the lymph channels and several

lymph nodes were seen to be outlined in black. This section shows how the carbon suspension could still flow into a node which contained a large metastasis. Most of the carbon is found in the normal part of the node although some of it penetrates a short distance into spaces between the cancer cells (Fig. 1).

3. Throughout the entire series a characteristic pattern of lymph node metastases was seen. The earliest metastasis was always found in the subcapsular space as in Figure 3. When the metastasis has grown larger than the small subcapsular lesion, the spread is by expansion around the subcapsular space and in the depth of the node. This expansion is usually accompanied by a thickening of the capsule especially over the area adjacent to the growth. There may be a more or less long layer of fibrous tissue between the cancer cells and the lymph cells. In many cases, there is so much interference with nutrition that we see a thick layer of fibrous tissue, a thin rim of live cancer cells within this, and necrosis in the center. Growth progresses until we see one or several large nodes, usually lying close to the main blood vessels, in which the lymphoid tissue is completely replaced by carcinoma. Groups of lymph nodes which are completely replaced by metastases tend to be found in certain regions. In specimens of carcinoma of the rectum and lower sigmoid, such nodes are usually located near the bifurcation of the superior hemorrhoidal artery (Fig. 4, No. 33779). In carcinoma of the breast, nodes about 1 inch below the brachial vein and along the lateral edge or just behind the pectoral minor muscle are the ones most likely to be completely replaced by carcinoma. The group of heavily involved nodes is along the main or primary line of lymph drainage. Nodes involved below or lateral to these nodes are apt to be subcapsular lesions or ones which are obviously late metastases.

4. In no case has there been any evidence of penetration of carcinoma outside of the capsule of any node except where there was a collection of large involved nodes lying tightly packed together. In cases in which this occurred the superior hemorrhoidal artery or the main artery supplying the region of the nodes was blocked by pressure of the nodes. Several

of these nodes contained necrotic material

5 In 7 cases retrograde metastasis to lymph nodes was found below carcinomas of the rectum. In every one of these enough of the nodes central to the lesion were completely replaced by carcinoma to make us feel certain that there was a very marked obstruction to lymph flow and the metastasis was by retrograde means (Fig. 4)

We will now study the 200 patients operated upon more than 5 years ago for carcinoma of the large bowel where there was a reasonable chance of cure (4). All of the surgical specimens were cleared and the lymph nodes were dissected under transillumination and the microscopically involved nodes were charted by the method described. The specimens used in this analysis were not always consecutive due to the work involved in the study of each one but were otherwise unselected except that the specimens from all fatalities were included. This results in somewhat higher mortality figures and lower 5 year survival rates.

These 200 patients represent an operability rate of approximately 75 per cent. Palliative resections for removal of tumor where known metastases could not be removed are not included in this group (Table I).

There is need for accurate anatomical location of tumors when discussing treatment of carcinoma of the rectum. The term *rectosigmoid junction* means different things to different surgeons. It can be located fairly accurately on proctoscopic examination. However it is impossible to identify on a surgical specimen. Roentgenologists often consider it a region 2 or 3 inches in length. This study has demonstrated the very different prognosis, recurrence and mortality rate to different regions of the colon. It seems to us that a new set of landmarks should be used. We have designated those carcinomas which are partially or completely below the peritoneal reflection as *extraperitoneal carcinoma*

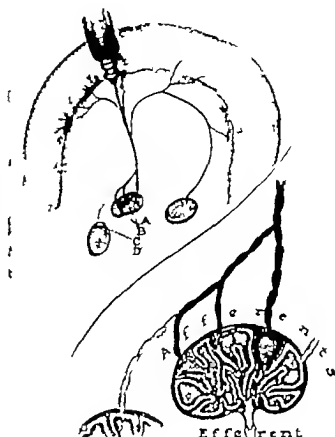


Fig. Showing the manner of spread of a suspension of insoluble particles injected into a single afferent lymph channel

of the rectum. There were 112 of these. Those lesions which are entirely covered by peritoneum anteriorly and which are below the promontory of the sacrum should be designated as *intrapertoneal carcinoma* of the rectum. There were 41 of these. Fourteen were in the redundant loop of sigmoid above the promontory of the sacrum. (These last 2—total of 55—will be grouped as one in this discussion as all findings were identical). Fifteen were in the right colon which included the cecum, ascending colon, hepatic flexure and the first 3 inches of the transverse colon. Eighteen were in the left colon which included all of the remainder of the colon to the redundant loop of the sigmoid.

One hundred and twelve tumors were partially or completely below the peritoneal reflection. There were 12 postoperative deaths and 4 had no follow up. Only 26 of the 69 with node metastases were alive after 5 years (37.5 per cent) whereas 32 of the 43 without

TABLE I.—200 CASES OF CARCINOMA OF THE COLON AND RECTUM

	Number	Per cent
Lymph node metastases present	125	62.5
Alive 5 to 10 years	14	57.0
Postoperative (hospital) deaths	19	9.5
Died 1 to 5 years—not carcinoma	8	4.0
Incomplete follow-up	7	3.5



Fig. 2

Fig. 2. Photomicrograph of lymph node almost completely replaced by carcinoma metastases. The normal parts are seen as dense, finely granular areas. A suspension of carbon particles was injected into the lymph channels in the neighborhood of the carcinoma of the breast. Most of the carbon is seen in the normal part of the node, although some of it penetrates a short distance along spaces



Fig. 3

between the cancer cells. A part of the lymph node which is involved with carcinoma also contains carbon particles. Areas of fatty degeneration are seen.

Fig. 3. Photomicrograph of carcinoma metastases which is confined to the subcapsular space. The thick capsule lying over the region of the metastasis is clearly demonstrated.

node metastases were alive 5 years (74.4 per cent)

Of the 69 with node metastases 30 or 43.5 per cent developed recurrent carcinoma in less than 5 years while only 5 or 11.6 per cent of the 43 without involved nodes developed recurrent carcinoma.

The incidence of local and liver recurrences in these low lying tumors is striking. If we subtract from the 69 with involved nodes the 16 patients who either died postoperatively in the hospital or were lost to follow up or those who died of other causes where there was no recurrent carcinoma the figure for local recurrence will be more than 30 per cent and almost 20 per cent for liver recurrence.

TABLE II.—112 EXTRAPERITONEAL RECTAL CARCINOMAS

	Number	Per cent
Alive 5 to 5 years	58	5.8
Postoperative deaths	3	0.7
Lymph node metastases present	69	6.9
Of 69 with node metastases alive 5 years	26	37.5
Of 43 without node metastases alive 5 years	3	74.4

Fifty five tumors were entirely above the peritoneal reflection. Fourteen were in the sigmoid and 41 were below the promontory of the sacrum. All findings were identical and these were grouped to save space. The favorable prognosis in this group and especially in those without lymph node metastases (60 per cent) is striking (Table IV).

Twenty seven of the 55 patients had obstruction resections performed. In many the extraperitonealization of the resected area was done as described by David. In the more unfavorable cases abdominoperineal resections were performed. This probably accounts for

TABLE III.—112 EXTRAPERITONEAL RECTAL CARCINOMAS

Recurrence	69 with node metastases		43 without node metastases	
	Number	Per cent	Number	Per cent
Local	16	3	6	6
Liver		5.9		6
Long, bone, general	3	4	3	3
	20	41.5	5	5

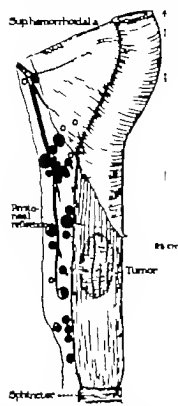


Fig. 4. Path No. 53779. This is operative specimen showing metastases to lymph nodes 4 centimeters below the carcinoma. The amount of each node replaced by carcinoma is shown in black. The largest nodes are 4 millimeters or more in diameter. A mass of large necrotic carcinomatous nodes caused almost complete occlusion of the superior hemorrhoidal artery just above its bifurcation.

the fact that the results with obstruction resections were about the same as with the abdominoperineal resections. Of the fifty-eight 18.1 per cent died of recurrence within 5 years the recurrence rates being similar in the 2 types of operations. The low incidence of recurrence here contrasts sharply with the 43.5 per cent seen in tumors which are extraperitoneal.

TABLE IV — 55 INTRAPERITONEAL RECTAL AND SIGMOID CARCINOMAS

	Number	Per cent
Alive 5 years	36	65.4
Postoperative deaths	4	7.3
Deaths not due to carcinoma	3	5.5
Had no follow-ups	2	3.6
Had node metastases	36	65.5
With node metastases alive 5 years	18	51.4
Of 20 without node metastases alive 5 years	18	90.0
No follow-up	1	
Postoperative death	1	
Obstruction resections	27	
Alive 5 years	18	66.6

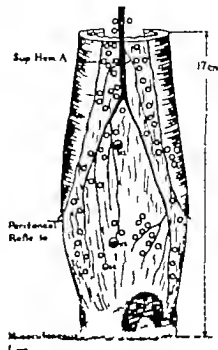


Fig. 5. No. 36682. A 64 year old man who had had symptoms for 3 months. This tumor was grade III Broder's and Duke's C. He developed a local recurrence in the hollow of the sacrum within 6 months. This finding of metastases in nodes high above low lying tumors is not uncommon even when only a few involved nodes are present. This seems to re-emphasize the necessity for wide resection of mesentery even when there are no palpably enlarged nodes.

Resections of the 33 patients with carcinoma proximal to the sigmoid colon were done by several different surgeons. Twenty-one had lymph node metastases (63.6 per cent). Twenty were alive 5 or more years (60.6 per cent).

Fifteen were in the right colon, all had ileo-transverse colon anastomoses at the time of resection. Thirteen or 86.6 per cent of these had metastases to nodes and in spite of 3 postoperative deaths and 1 lost to follow up 9 were known to be alive after 5 years (61.5 per cent). These operations were performed before the era of chemotherapy therefore the operative mortality in this group would be lower at this time.

Eighteen tumors were in the transverse or descending colon. Only 8 had node metastases.

TABLE V — RECURRENCES IN 55 INTRAPERITONEAL TUMORS

	N	patients	Per cent
Local	2		3.6
Liver	6		10.9
Lung or general	2		3.6
Total	10		18.1

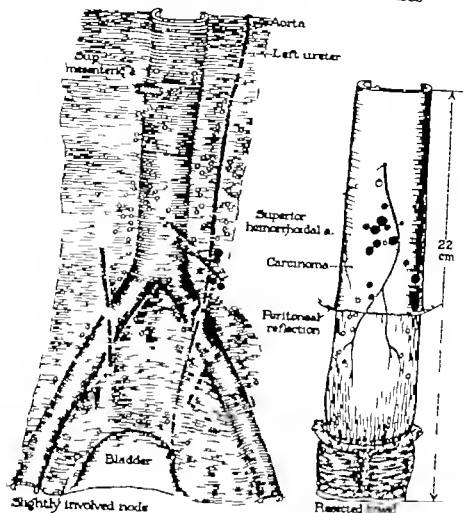


Fig. 6. No. 4177 Seventy two year old man who had had symptoms for 4 months. The surgical specimen contained 46 lymph nodes. Fourteen of these contained metastases. He died of pneumonia. The autopsy specimen contained 14 lymph nodes. Four nodes above and one node just lateral to the field of resection contained metastases. This is an example of metastasis laterally along the levator ani muscle as well as up and along the superior hemorrhoidal artery. In spite of a very large tumor the lymphatic metastases are localized to an area which could have been resected.

(44.4 per cent) This is the lowest incidence of involved nodes seen. Five of these 8 died of recurrence within 5 years. Only 3 of the 8 lived 5 years (37.5 per cent) in contrast to 80 per cent of those without involved nodes. All of

these had obstruction resections. There were no postoperative deaths and one was lost to follow up. This suggests that resection in this area has been too conservative.

TABLE VI.—15 TUMORS OF RIGHT COLON ALL WITH ILEOTRANSVERSE COLON ANASTOMOSES

	Number	Per cent
Alive 5 years	9	60.0
Had involved nodes	13	86.6
With involved nodes, alive 5 years	7	53.8
Postoperative deaths	3	
Had no follow-up	1	

TABLE VII.—18 TUMORS OF LEFT COLON ALL OBSTRUCTION RESECTIONS

	Number	Per cent
Alive 5 years	6	6.1
Had involved nodes	8	44.4
With involved nodes alive 5 years	3	37.5
No postoperative deaths		
Of 10 without nodes alive 5 years	8	80

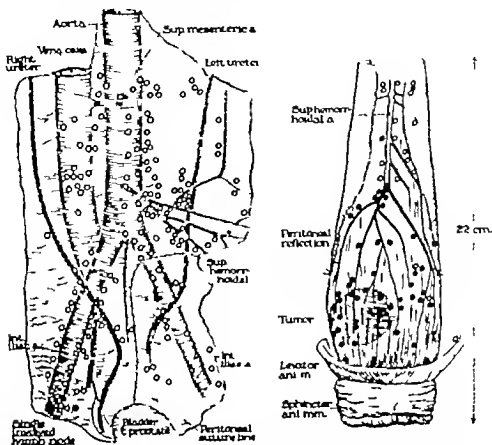


Fig 7 No. 36903 A 63 year old man who had had symptoms for more than a year. Biopsy was made of this carcinoma 12 months before, but he had refused operation. The tumor was ulcerating and it had penetrated all coats of the bowel. Nodes were palpable in the hollow of the sacrum. Sixty-two nodes were found in the surgical specimen. 43 of them showed metastases. He died of a pulmonary embolus on the eighth postoperative day. One hundred sixty retroperitoneal nodes were examined microscopically. In spite of the extensive lymph node involvement, there were no metastases above the point of resection. The one node involved was about 1 centimeter lateral to the widest point of resection along the levator ani muscle.

The surgeon gave a guarded prognosis at the time of resection because of grossly enlarged lymph nodes in 55 of the 200 cases

Table VIII indicates the prognosis in those having palpably enlarged nodes proved to have metastases on microscopic section

TABLE VIII.—55 OF 200 GIVEN GUARDED PROGNOSIS DUE TO LARGE NODES

Location of tumor	Alive 5-7 yrs	Died 0-5 yrs	Post operative deaths	Recurrences			Deaths not carcinoma	Total patients
				Liver	Local	General		
Extraperitoneal								
With nodes	5	6	3	3	6			
Without nodes								3
Below promontory								
With nodes	6			5		3		6
Without nodes	6							6
Colon								
With nodes	4	5		—				9
	2	2	5	2	7	6	4	55

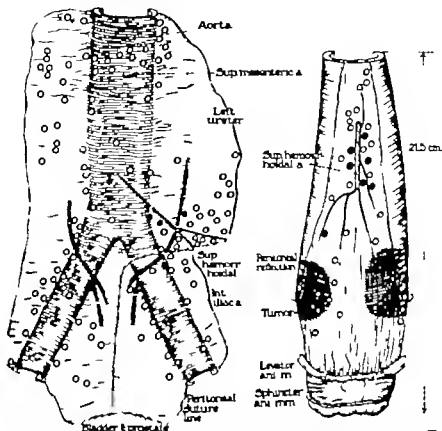


Fig. 8. No. 36642. A 72 year old man. II had had symptoms for 6 months. The surgical specimen contained 35 nodes and 7 of these contained metastases. II died of bronchopneumonia. One hundred eleven nodes were studied in the postmortem preparation. 4 contained carcinoma. The highest metastasis was in node found at the junction of the inferior mesenteric artery and aorta.

Small scars (grains of sand nodules) were palpated in the liver in 11. These were too small and indefinite to be considered metastases. Eight lived 5 years. One died after operation. One developed a local recurrence and one who had no recurrence died of diabetes. These small lesions are usually almost of one size and the occasional operator should not be influenced adversely when they are found (Table IX).

Thirty five of the 200 patients required resection of all or part of other structures because of firm fixation of the tumor (Table X).

TABLE IX. — POOR PROGNOSIS DUE TO SUSPICIOUS NODULES IN LIVER — 11

	Number
Alive 5 1/2 years	8
Died in less than 5 years	3
Postoperative death	1
Local recurrence	
Diabetes, not carcinoma	

Fourteen or 40 per cent of these patients were well 5 years. This figure would be higher today as 7 or 20 per cent died after operation. This mortality would be favorably influenced by chemotherapy. Wide excision of structures adherent to the tumor is justified by these findings.

Seven patients having carcinoma below the promontory of the sacrum had metastases to lymph nodes distal to the tumor. Such metastasis occurs when there is lymphatic blockade. This finding re-emphasizes the necessity for extensive resection in those having enlarged nodes and large tumors.

Abdominoperineal resections of the rectum were performed in 140. Four of these were two stage resections. In 2 resections of other structures made a mass of tissue too large to pull through the pelvic outlet in the male and in these the rectum was cut off just above the anus and the stump was closed. In all of these

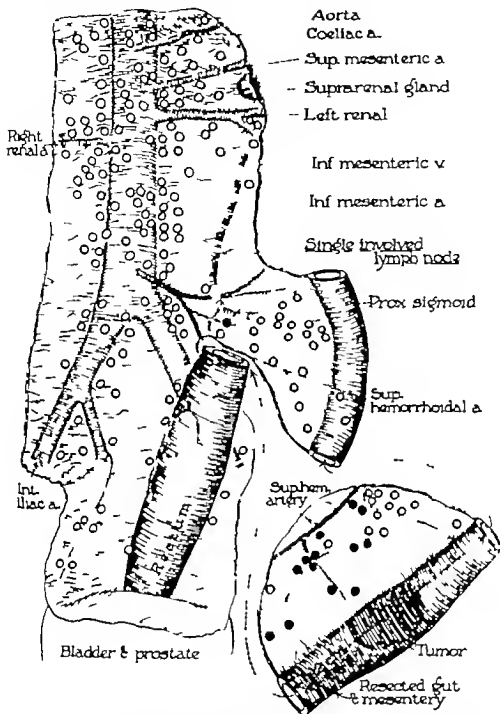


Fig 9. No. 37719. A 66 year old fat man. He had had a known coronary thrombosis 10 months before. The lesion was 1 inch above the peritoneal reflection. It was the size of a fist and there was a mass of nodes extending to the promontory of the sacrum. A David type of obstruction resection was performed. He died 14 days after surgery of myocardial failure. One hundred sixty-eight nodes were found in the postmortem preparation. The one involved node was less than 1 cm. beyond the line of resection.

there was an average of 55.3 nodes per specimen sectioned and studied microscopically. One specimen contained 210 nodes and 6 had 112 or more nodes each. Those having an obstruction resection of the sigmoid or intra-pentoneal rectum averaged 41.6 nodes per

specimen and one specimen contained 102 nodes. Specimens from obstruction resection of the left colon averaged 40 nodes each and one had 69 nodes. Specimens of the right colon obtained by resection and primary ileotransverse colon anastomosis averaged 54 nodes

TABLE X.—35 CARCINOMAS REQUIRING RESECTION OF ALL OR PART OF OTHER STRUCTURES

	No. patients	Well 3 yrs	Postoperative deaths	Recurrence			No. alive 9
				Local	Liver	General	
Peritoneal fascia	8	3		3			
Abdominal wall	4	3					
Ureter and bladder			8				
Vagina	4	3					
Urethra and prostate							
Uterus	3						
Rectal							
	31	24	7	7	1		

each with one having 115. Seventy two of the 125 specimens having metastases to lymph nodes had 4 or less nodes involved per specimen

In low lying carcinomas of the rectum small high lying lymph nodes not uncommonly are found to contain metastases. Specimen No. 36682 is typical of such cases and serves to re-emphasize the fact that the widest possible resection of the mesentery is needed to give a chance of permanent cure (Fig. 5).

Four or less involved nodes in 72 of 125 with involved nodes (Table XII).

Three patients were pregnant when the carcinoma of the rectum was discovered. Two have long time cures (Table XIII).

The first and third patients had full term deliveries 1 or 2 months before surgery. The second patient had an abortion at 4 months.

New carcinomas have developed in 7 of the 200 patients. In each of these cases there is very strong evidence to suggest that these are new tumors and not metastases (Table XIV).

The patient with a previous resection, either with or without a colostomy must be watched carefully or these new tumors may cause almost complete obstruction before they are discovered.

When there is a double blood supply to the region of the tumor there is usually a double lymph drainage. We have a number of instances of carcinoma at, or just below the peritoneal reflection in which we have found metastases to small nodes about 2.5 centimeters lateral to the bowel wall, along the superior surface of the levator ani muscles. Also, either squamous cell carcinoma or adenocarcinoma involving both the mucosa and the perianal

TABLE XI.—RETROGRADE METASTASES TO LYMPH NODES IN CARCINOMA BELOW SACRAL PROMONTORY

	Distance below tumor—cm
1th Involved nodes	3.5 to 5
1th Involved nodes	5 to 3.5
3 1th Involved nodes	to 5

TABLE XII.—NODES INVOLVED

	Average number nodes	Most nodes per specimen
Operation		310
Miles	55-3	
Obstruction resection—		
sigmoid and rectum	4, 6	102
left colon	40-8	69
right colon	54	5

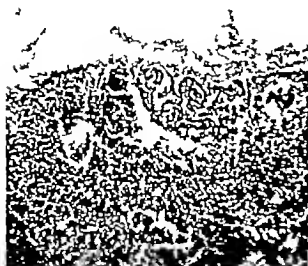


Fig. 6. No. 377 p. Photomicrograph of the entire amount of carcinoma metastasis found in the one involved node which was not removed in the surgical specimen.

TABLE XIII.—PROGNOSIS IN PREGNANCY WITH CANCER OF THE RECTUM

Case	Age	Per cent Circulation Bowel	Location	Duration symptoms	Operation	Died	W II
	23	65	Intra-peritoneal	6 mos.	Obstruction resection	Yrs.	
	34	72	Extra-peritoneal	6 mos.	Miles		9 yrs.
3	35	80	Extra-peritoneal	4 mos.	Miles		7 yrs.

TABLE XIV.—NEW TUMORS (EXCLUSIVE OF SKIN)

	Nodes & operation	Polyps	Location of new tumor	Died	W II
Extrapertoneal	+		Transverse colon 7 yr		9 yrs.
2. Transverse colon	+		Rectum 3 yrs. Descending colon 4 yrs.	2½ yrs.	
3. Intrapertoneal			Splenic flexure 1½ yrs.		5 yrs.
4. Intrapertoneal		+	Descending colon 4½ yrs.	4 yrs mos	
5. Left colon	+	+	Cecum 7 yrs.	8 yrs.	5 yrs.
6. Left colon	+	+	Breast 4 yrs	4½ yrs.	
7. Intrapertoneal	+		Common duct yrs.	2 yrs.	

skin may have metastases upward to nodes along the superior hemorrhoidal artery as well as to the inguinal nodes. In some cases both groups have been involved. This must be considered when planning surgery.

If we exclude those patients who have died of other causes without any sign of recurrent carcinoma and those who had no follow up and those who died postoperatively the prognosis would be as shown in Table XV.

The most striking finding here is in those tumors of the transverse colon, splenic flexure and descending colon where nodes were involved. All of these had obstruction resections and only 3 of the 8 (37.5 per cent) were alive 5 years. The widest possible resection is indicated here rather than the usual V shaped wedge of mesentery resected. The favorable prognosis (77.7 per cent) seen in right colon lesions having involved nodes is undoubtedly due to the wide resection of mesentery (54 nodes per specimen) performed when doing an ileotransverse colon resection and anastomosis.

Nineteen died in the hospital after surgery. Eight had no postmortem examinations. Three had postmortem examinations and the usual search was made for metastases to retroperitoneal nodes but none were found al-

though all three had had lymph node metastases in the surgical specimens.

In the remaining 8 all of the retroperitoneal tissues from the celiac axis (Fig 6 No 41772) to the base of the bladder and prostate were cleared and 96 to 168 lymph nodes (Fig 7 No 36303) were examined in each. Two who had no nodes involved in the surgical specimen were free of metastases in the cleared

TABLE XV.—166 CASES OF CARCINOMA OF THE COLON

	Number	Alive 5 yrs.—Per cent
114 alive 5 years	114	68.7
Of 89 extraperitoneal rectal	58	65.5
Of 48 intraperitoneal rectal	36	75.0
Of 22 right colon	9	82.8
Of 18 left colon	11	61.1
Of 100 with involved nodes	54	54.0
Of 66 without involved nodes	60	90.9
Of 53 extraperitoneal with involved nodes	26	49.1
Of 36 extraperitoneal without involved nodes	32	88.8
Of 50 intraperitoneal with involved nodes	18	60.0
Of 18 intraperitoneal without involved nodes	18	100.0
Of 9 right colon with involved nodes	7	77.7
Of 2 right colon without involved nodes	2	100.0
Of 8 left colon with involved nodes	5	37.5
Of 10 left colon without involved nodes	8	80.0

postmortem preparation (Fig 8 No 36642) Four who had metastases in the surgical specimen also had metastases in the cleared specimen. In 3 of these 4 (Fig 9 No 37719) the involved nodes remaining after surgery could have been removed if the resection had been 15 centimeters wider! In one a resection of all of the inferior mesenteric artery would have been needed to remove all involved nodes (Fig 10, No 37719-139) These findings re-emphasize the fact that we must not limit the resection of lymph node containing tissue in carcinoma if we strive for permanent cure.

CONCLUSIONS

1 In this study of 200 patients having resection for carcinoma of the colon there was a 96.5 per cent 5 year follow up. One hundred and fourteen were known to be alive 5 to 10 years (57 per cent). In the study of the surgically removed specimens, microscopic sections were made of over 10,000 different lymph nodes, carefully plotted as to location to tumor and surgical landmarks. A number of facts stand out.

2 There is a real need for uniform and accurate description of the location of the tumor when discussing the value of different operative procedures in carcinoma of the colon and rectum. We have suggested an easy and accurate method for locating those tumors below the promontory of the sacrum.

3 Cases of palliative resections where known metastases are left in the liver, lung, etc., should not be included in discussions of surgery for cure of carcinoma, since the inclusion of such cases tends to confuse the reader.

4. The 37.5 per cent 5 year survival rate of those having carcinoma of the left side of the colon when lymph node metastases were present indicates the need for the widest possible resection of mesentery rather than the usual V-shaped wedge of mesentery resected in these cases. The favorable prognosis seen in right colon lesions having involved nodes is undoubtedly due to the wide resection of mesentery (54 nodes per specimen) performed when doing an ileotransverse colon resection and anastomosis.

5 Retrograde metastases to nodes 1 to 3 centimeters below the tumor occurred in 7 of the 153 tumors below the promontory of the sacrum (4.6 per cent).

6 New carcinomas developed in 7 patients who had had resections. This does not include carcinoma of the skin. In some, the diagnosis was not made for several months after symptoms appeared. Patients who have had cancer of the colon should be re-examined carefully whenever any symptoms suggesting carcinoma appear.

7 In evaluating the type of procedure used in treating carcinoma the survival rate is important. Of those who died of recurrence less than 5 years, two-thirds occurred within 3 years and one third between 3 and 5 years. Six of those listed as 5 year cures developed recurrences and were dead or dying in less than 7 years. In view of the appreciable percentage who develop recurrence in the fourth and fifth year after operation, it seems unwise to consider anything less than a 5 year survival as a cure. Such short term survivals should not be included in discussions since they lead the general practitioner to false conclusions.

8 In carcinoma at and below the peritoneal reflection where lymph node metastases were present in the surgical specimens, 23.9 per cent developed local recurrences and 15.9 per cent developed liver recurrences within 5 years.

9 Postmortem examination of those dying in the hospital after resection for carcinoma of the rectum showed that the ordinary postmortem examination will usually fail to demonstrate small metastases in the remaining retroperitoneal lymph nodes. Four of 11 who had postmortem examinations were found to have metastases to nodes in the retroperitoneal tissues. In 3 of these, complete removal of all node metastases would have been obtained if the field of resection had been 15 centimeters wider. It is interesting to speculate on the fate of the cancer cells left in these nodes had the patient lived. In some, inflammation might have resulted either in death of the cells or fixation in heavy fibrous tissue. It is not unlikely that such metastases in lymph nodes mislaid at operation finally grow. They might grow to great size without giving symptoms.

We have sections of the blood vessels supplying involved lymph nodes being invaded by cancer. Possibly emboli from such a source might be responsible for the sudden appearance of multiple metastases many years after resection of the primary growth.

Finally this study indicates the need for the widest possible resection in carcinoma of the colon. Lesions which are partially or completely below the peritoneal reflection have a high incidence of local and liver recurrence. The Miles operation seems to give the best chance of cure here.

As far as lesions within the peritoneal cavity are concerned, we have performed obstruction resections on several in this series that could be palpated when doing a rectal examination. This is justified if not only the bowel wall but the blood vessels and lymph bearing tissue are resected at least $1\frac{1}{2}$ to 2 inches below the lesion as well as to a point just distal to the first sigmoid artery: this is a point about $1\frac{1}{2}$

to 2 inches above the promontory of the sacrum. If such resection is not done involved nodes will be missed. The David extraperitoneal procedure will allow for such a resection in many. If after such an extensive resection of mesentery there is still an adequate blood supply to the distal loop we do not object to an end to end anastomosis. The real question in the discussion about end to end anastomosis is missed: it seems to us. It should be: Can you remove all of the cancer? and not: Can you sew two ends of bowel together? Obviously in those intraperitoneal lesions below the promontory of the sacrum which are large or have palpably enlarged nodes the abdominoperitoneal resection will give a greater chance of cure.

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EDITORIALS

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ESOPHAGITIS

IN recent years much has been written concerning diseases of the esophagus. Carcinomas of the esophagus are found rather commonly and thoracic surgeons are performing resections of the esophagus for this condition with increasing frequency. Many articles are appearing in the literature concerning the therapy of cardiospasm, congenital anomalies, cicatricial strictures, diverticula and benign tumors of the esophagus. Such topics as functional dysphagia, the Plummer-Vinson syndrome, esophageal perforations, foreign bodies and esophageal varices have received their share of consideration.

Although the aforementioned conditions have been discussed rather widely, esophagitis is a subject that has not received the attention it deserves in medical literature. A number of years ago Vinson and Butt¹ stated that esophagitis occurs more frequently than does any

other condition which affects the esophagus. In the course of some 3,000 necropsies they found evidence of esophagitis in 7 per cent of the cases. Yet in the review of the records of these patients they found that symptoms of esophagitis were recorded in only 10 per cent of the group of patients who subsequently were found to have inflammation and dilation of the esophagus. Apparently esophagitis is a condition which is seldom recognized during a patient's life. Paul² has stated that acute ulcerative esophagitis is a common finding at necropsy but rare in clinical practice.

Esophagitis is a condition that should be of great interest to the surgeon. It usually occurs in patients who have diseases which require surgical treatment or in patients who have undergone major surgical operations. Vinson and Butt found that in 75 per cent of their 213 cases of esophagitis the patient had been operated upon a short time before. The disease is encountered most commonly in patients who have gall bladder disease, duodenal ulcer,³ obstructing lesions of the gastrointestinal tract and esophageal hiatal hernia. Selye⁴ was able to produce hemorrhagic esophagitis by ligating the pylorus in experimental animals. In some instances, esophagitis appears to follow severe infections of the upper part of the respiratory tract.

Why does esophagitis occur? Certainly a number of factors are involved and deserve consideration. The trauma caused by the passage of nasal tubes may predispose to esophagitis. Certain abdominal conditions and operative procedures require that such

¹Vinson, P. P. and Butt, H. R. *J. Am. M. Ass.*, 136, 66 (1940).

²Paul, L. W. *Radiology*, 94:4, 421-430.

³Benedict, E. B., and Daland, E. M. *New England J. M.*, 1938, 309-307.

⁴Selye, Hans. *Canad. M. Ass. J.*, 1938, 39: 477-484.

tubes remain in place for a considerable period of time. However, I doubt very much that introduction of nasal tubes alone is often responsible for serious esophagitis although in the presence of pre-existing esophagitis it may do a great deal of harm.

Attention should be called to the occasional occurrence of perichondritis and stenosis of the larynx as a result of use of a nasal tube in the esophagus. Strictures in the vicinity of the cricoid cartilage are particularly susceptible to the pressure effects of such tubes. Although the use of nasal tubes is a valuable adjunct to the therapy of some abdominal diseases these tubes should be used with discretion and for as short a time as is possible.

More commonly esophagitis is caused by the reflux of gastric secretions into the esophagus. These digestive juices are very irritating to the esophageal mucosa. Esophagitis is likely to occur in association with abdominal diseases that produce excessive vomiting. In competence of the cardiac sphincter likewise results in regurgitation of gastric acids into the esophagus. The cardiac sphincter is in competent in many cases of esophageal hiatal hernia and esophagitis frequently is associated with hiatal hernia. Years ago Harvey Cushing¹ called attention to the frequent occurrence of esophagitis and esophageal ulceration in patients with lesions of the brain. Pathologists often describe ulcers of the esophagus in cases in which death was due to brain tumor.

The symptoms of esophagitis frequently are overlooked. Such terms as "heartburn" and "sour stomach" often are used by patients to describe a substernal and epigastric burning sensation caused by inflammation of the lower part of the esophagus. In cases in which the disease is severe patients may complain of substernal pain sometimes referred up to the

throat and neck and even into the arms. Such pain usually indicates esophageal spasm and some of the cases fall into the category described by Moersch and Camp² as diffuse spasm of the esophagus. In such cases severe dysphagia may develop. Of interest is the work of Dey and his associates³ who demonstrated that reflex spasm and shortening of the esophagus may be produced in experimental animals by stimulation of the vagus nerves by manipulation of the stomach, liver and other abdominal viscera and by distention of the gall bladder.

In cases of severe ulcerative esophagitis hemorrhage may occur. In their series of cases in which necropsy was carried out, Vinson and Butt found that 32 of 213 patients had presented symptoms of esophagitis. Of these 32 patients 53 per cent had complained of substernal burning, 40.8 per cent had had hematemesis and 28 per cent had complained of difficulty in swallowing. In view of the fact that in all of Vinson and Butt's cases necropsy was performed, they are not representative of the usual cases seen clinically. The majority of patients who have undergone operation will not describe symptoms of esophagitis unless careful inquiry is made.

In most cases esophagitis probably subsides without leaving any ill effects. However, repeated episodes of esophagitis lead to a progressive cicatrization of the lower part of the esophagus. Recently Harrington and I⁴ have shown that an actual shortening of the esophagus may occur with stricture at the esophago-gastric junction. Repeated episodes of ulcerative esophagitis and healing of the esophagus are usually responsible for the short esophagus type of esophageal hiatal hernia. This condition most commonly occurs in association

¹Moersch, H. J. and Camp, J. D. *Ann. Otol. Rhinol.*, 1934, 43, 105-73.

²Dey, F. L., Gilbert, N. C., Trump, Ruth, and Rockefley, R. C. *J. Lab. Clin. M.*, 1946, 3, 490-506.

³Olsen, A. M. and Harrington, S. W. Unpublished data.

⁴Cushing, Harvey. *Surg. Gyn. Obst.*, 1911, 55, 34.

with duodenal ulcer gall-bladder disease and other abdominal diseases which produce regurgitation of gastric secretions. Esophagitis and shortening of the esophagus may develop in cases of hiatal hernia because of reflux of gastric acids into the esophagus. In cases of short esophagus with intrathoracic stomach usually the shortness is not congenital. Shortening is caused by recurring ulcerative esophagitis and is frequently secondary to surgical lesions of the abdomen. The conclusions reached by Harrington and me were similar to those reached by Allison¹ and by Smithers.²

The fact that esophagitis is not an uncommon complication of disease of the upper part of the abdomen must be recognized. When surgical intervention is indicated it should not be delayed. Gastric secretions should be neutralized with antacid preparations in cases in which these secretions are regurgitated into the esophagus. At times elevation of the head of the patient's bed is helpful in preventing a reflux of gastric acids. In the postoperative period inquiry should be made concerning symptoms suggestive of esophagitis. Nasal feeding tubes should be used with some discretion when the presence of esophagitis is suspected. Sometimes esophagoscopy is indicated. If cicatrization and stricture occur relief of dysphagia usually can be obtained by dilatation performed over a previously swallowed thread.

ARTHUR M. OLSEN

PREPUBERTAL MELANOMA OF SKIN

however seems to proceed after birth with exposure to light. In other words, the elaboration of the pigment does not seem to occur greatly *in utero*. By the time the child is a few years old these tumors become much darker in color. Many of them do not increase in dimension except proportionately with the rate of the growth of the child. It is evident in studying the phenomena of the development of pigmented nevi that many of these nevi are not at all visible until after the onset of puberty. A child with a few scattered pigmented moles here and there may in company with the endocrine changes attendant on the state of puberty have the rather sudden development of numerous pigmented nevi over the skin of the face, trunk and extremities. It is assumed that these are not new-growths, in the strict sense of the word, but that the congenital misplacement of these cells may have been present but unrecognized until influenced by the hormonal factors so increased at this time. The nevi also undergo some remarkable pigmentary changes with the onset of puberty in that they become much more darkly pigmented and have a tendency to become elevated above the level of the surrounding skin.

There is one important type of pigmented nevus which bears such a close resemblance to malignant melanoma that it is not possible, clinically, to distinguish between the two. This nevus may be found in children from ages of one to the time of puberty. Usually they are rather darkly pigmented, bluish, blue, black, or dark brown in color, smooth and well

tered in adults. Even though the tumor has structurally the conformation of the true melanoma it ordinarily does not behave as such until after puberty. Our experience with now more than nine hundred cases of malignant melanoma has been that none of these melanotic tumors of infancy and childhood has metastasized to regional lymph nodes although many of them have been labeled as malignant melanoma by extremely competent pathologists. This fact is now so well recognized that our pathologists insist on having clinical information available concerning the age of the individual and whether or not evidences of approaching puberty exist. For example a diagnosis of juvenile cellular nevus may be made on a tumor excised from an adolescent boy only to discover some months later that inguinal lymph nodes contain metastatic melanoma the youth showed evidences of pubertal changes. We might well adopt such a term as *prepubertal melanoma* to indicate the group of tumors which resemble malignant melanoma histologically but do not behave as such.

It is our belief therefore that the malignant melanoma in its derivation from the pigmented nevus is a tumor closely related to the endocrine system and markedly influenced by the activity of the endocrines notably the gonads, the suprarenal cortex, and the hypophysis. In keeping with this opinion, we have often observed malignant melanomas to occur in adolescent girls and boys just after the age of puberty and furthermore we have commented on the extremely rapid growth and wide dissemination of these tumors at this early age. Apropos of these statements concerning the stimulation of the tumor by hormones, it may be mentioned that we have never seen a patient who developed a malignant melanoma during pregnancy survive for any length of time. We have had quite a

number of instances in which a pigmented nevus underwent malignant degeneration into melanoma during pregnancy or shortly thereafter and when this occurred the tumor grew with startling rapidity and was usually widely disseminated without control by surgical excision however radical or by any other methods of treatment.

The significant conclusion to be drawn from these observations is the obvious necessity for complete surgical removal of all dark deeply pigmented nevi in childhood. Their removal in infancy and childhood entails very minor surgical procedures without the hazards of recurrence. It may be a serious mistake to delay this operation until some evident change has occurred in the appearance of the tumor sufficient to cause worry particularly if this change develops at the time of or shortly after puberty. In reviewing the end results of the treatment of melanoma at the Memorial Hospital the number of 5 year survivals without recurrence (definitive cures) was only 50 per cent as good in the group of patients whose ages extended from puberty to 25 years as it was in the older age group. A microscopic diagnosis of melanoma in a skin tumor removed during infancy and childhood does not call for an extension of radical surgery such as wide excision and skin grafting and dissection of regional lymph nodes, provided the child has not entered the pubertal stage. This last statement is based solely on our personal experience at the Memorial Hospital in a series of more than 900 malignant melanomas. When we investigated the rumored instances of metastasizing prepubertal melanoma from other hospital sources we encountered only one instance in which the sectioned lymph node contained apparent melanoma cells in the other instances the tumors were bizarre and of uncertain histogenesis.

GEORGE T. PACK



From *The History of England* by David Hume. London: Cadell, 1796.

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THE BOOK SHELF

BELLS TOLL FOR PRIMES

An Inquiry into the Fate of William the Conqueror

FRANCES TOMLINSON GARDNER San Francisco California

THE deathbeds of personages of historical importance are pried into with the enthusiastic curiosity of small boys turning over a dead lizard. Human nature enjoys meditation on the fact that the last mortal moments of the great are very similar to and no more comfortable than those of the common herd. It is pleasing to learn that the mighty of the past, though surrounded by voluminous soiled velvet and many dented golden vessels, still writhed on the same old bed of pain.

So William the Conqueror met death. Praying, declaiming and groaning, he departed this life on the 9th of September 1087. In the depths of the Middle Ages when medical observation was at its lowest ebb and his devoted attendants so consumed by their eagle-eyed watch for the devil or any hovering angels that their interest amounted to espionage. They remembered every word of his remarkable deathbed discourse and were admiringly attentive to the manner in which his departing spirit met its Maker, but all they knew about his illness was that he was very stout, had gotten very hot and tired and had bumped into the pommel of his saddle. They gave never a thought to what, in William's life, food habits, and manner of living bore upon his painful end, or what mechanics of the body caused that end.

He was born in the last month of 1027 or a very early month in 1028 to Robert, Duke of Normandy and his mistress, Harleve, also called Arlette, the beautiful daughter of the local tanner. His father somewhat vividly known as Robert the Devil, died at the age of 35 in the traditional best manner while on a pilgrimage to the Holy Land. His mother taking his little sister Adeliz by the hand, soon went off to marry Herlewin of Conteville, by whom she bore two half brothers for

William and Adeliz. These were trying and turbulent Odo, later Bishop of Bayeux and Earl of Kent, and Robert, Count of Mortain, just a normal unimpressive relative.

In his youth and middle age William was stocky but well proportioned with a neck somewhat longer than the average and shoulders so wide and powerful that even in his waning years he could pull, while seated on his horse, a long bow too heavy for his archers standing on the good firm earth. His life was one spent in fighting, brawling and battle, but in spite of all to which his body was subjected no mention is made of any wound or debility until he was a man in his fifties, a comparatively ancient age for the eleventh century. He was, by nature, an aggressive extrovert. He was ruthless, brutal, stern, frightening, kind, gay and loving all to an extreme degree. In the interests of his position in life he cultivated an expression of ferocity which went well with his high bald forehead and which frightened away much weak-hearted opposition.

Dietetically he was seasonal, which was forced upon him and all his fellows by the ignorance of the times. In the good months of the year he ate his beef, boar, venison, and mutton for breakfast, lunch, and dinner. Since his kitchen contained nothing that would approximate a modern stove his meat was roasted on a spit turned by a half-hearted kitchen boy and served red and dripping. Consequently though not very hygienic and frequently full of parasites, it presented his inner economy with all its available vitamins. He partook occasionally of chicken, and very reluctantly on fast-days, of fish. He refused to have much to do with the few vegetables of the time, frowning on them as women's fare, but he could be coerced into real enjoyment of a 'mortreux'—a meat and vegetable stew, provided it was fancily dressed and accompanied by plenty of rich sweet

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liquor usually mead. His flour made up into large round loaves or served as his favorite dessert, bag pudding a kind of forerunner of modern apple pudding was roughly ground and often unbolted and retained all its useful vitamins. His garden supplied him with wizened but succulent little plums, apples, and pears for a finish for his gigantic trencherings.

The picture was very different in the winter. All the meat was crudely dried, salted, or pickled. There were few if any vegetables. The fruit was gone and the flour was damp and moldy. William ate so badly that he like all his people met the return of spring with his annual touch of scurvy as commonplace in those days as spring fever. William ate of the fat of the land, but in cold winter the land was, indeed, not very fat.

William may have had trouble with constipation brought about by a combination of such things as diet, winter restrictions on his customary exercise, and the lack of reasonable hygienic arrangements about his castle. I do not mean to infer that anyone of the period was squeamishly modest, but icy cold castles can force a certain added reluctance on a sluggish colon. William may have built up a strong tendency to a condition which, as his years grew longer could well have become chronic.

Somewhere between his fortieth and his fifty-ninth year serious changes took place within the previously impervious body. He grew corpulent out of all proportion to his build and in 1086 when he was about 58 was forced to take to his bed, in Rouen under care of what physicians were available, for the reduction of his "corpulence." This obesity seems to have been genuine fat, honestly come by since nowhere is there mention of tapping or of water logged tissues. Had there been there would have been comment, because if there was any condition an eleventh century doctor could recognize it was the presence of edema. By the process of eliminating other things excluded by William's physique and activities and the silence of his contemporaries we can omit ulcer, cancer, hernia, heart and kidney disease. However it is not in the character of such a man to lie meekly in an uncomfortable bed for several weeks when enemies all around him might take advantage of his impotence so that something greater than simple adiposity forced him to give up.

It is a fair guess that William was suffering from diverticulitis of the colon. It would be impudent of an author writing today using the little information which is available, to declare just where the diverticula might be or whether there were many of them. Perhaps it is presumptuous even

to suppose that he had them, but his 172 lb. vague distress, his grossly fat body and his probable chronic constipation clamor their acceptance of the condition. A long history of epigastric discomfort which evidently also had long periods of remission and comparative comfort, coupled with no history of anything startling in addition, points to a comparatively asymptomatic diverticulosis which gradually becoming more and more unmanageable, finally put William to bed. It is a predicament which, in its subtle obscenity would unquestionably baffle an eleventh century physician whose treatment could consist of little more than emetics, purges, and bed-rest.

While he was reposing at Rouen his own Philip King of France, found time to be cross about him. In public, Philip remarked that he was surprised that his Brother England should be so long a time in being delivered of his big boy. This uncouth insult was promptly conveyed back to the sick room where its effect was volcanic. William was not devoted to Philip at any time but had a little bone to pick with him in the matter of the Vexin a province once his own which, through many involved negotiations between vassals and overlords, had been annexed by Philip. For 10 years William had been too busy to get it back again but now he seized upon the old quarrel as a pretext to retaliate for Philip's spiteful comment which William interpreted as likening him to a woman lying-in. He rose from his bed with a roar exclaiming that, at his churching, he would set all France ablaze. This cryptic statement referred to the custom of a woman carrying a candle to her churching after childbirth. William would allow no one, least of all the King of France, to suggest that he was womanish.

The last week of July 1087 he appeared suddenly before Mantes which he besieged and, on the 10th of August, took. On entering, his orders to his troops were "scatter, pillage, and burn," which they obeyed to the letter. They removed everything movable and burned everything inflammable, including the churches and the standing corn. The huge, sick, old man rode everywhere, shouting and scowling. The summer heat was torrid and the flames from the burning buildings added nothing to the comfort of man or beast. William's horse, weary from the enormous weight of its rider heavier than ever because of his anorexia, excited by the flames and guided by a careless hand, stepped upon a burning ember. It was said solemnly at the time, that God caused this to happen as punishment for the terror visited upon the town. Doubtless William deserved the punishment but it is more likely that God was out-

piled elsewhere and that the flaccid old body taken by surprise could not counter the startled leap of the charger. He was flung against the high hard pommel of his saddle and something serious happened within him.

He was carried back, by litter to Rouen. Physicians arrived in the persons of Gilbert Mamnot, Bishop of Lisieux, and Goutard, Abbot of Jumièges with some others well skilled in medicine. These learned and holy counsellors hovered around his bed during all the few weeks which remained of his life hung adoringly on each word of his noble and long winded confession and oration which filled his last days, exorcised his spiritual devils, and seem to have entirely omitted to bother about his physical ones. Word for word of his conversations with his sons, his bequests of his substance his speeches to the holy family have been given us but neither Gilbert nor Goutard left so much of a clinical note as 'vomited or fevered'

He languished at Rouen. The heat was terrible as were the stinks and flies of that medieval city. So were the shouts and cries of peasants and market folk and driven cattle and all the thousand noises of the narrow streets. William asked to be taken to the church of St. Gervase which lay a short way out of the city. His physicians agreed to the brief journey and he was installed in the priory there where breezes blew away some of the heat and the only noise was made by the quiet steps of soft footed monks.

During the 4 weeks of his dying William's mind was as clear as his body was agonized. In his famous deathbed oration which must have continued daily for most of the period of his last illness, he confessed to all his sins and depredations, apologized to those he had wronged and begged the forgiveness of the church for all he had done against it, none of which of course had he done intentionally. He called his sons William Rufus and Henry to his side and gave them his bequests in his own voice. Robert, the eldest was in Germany. William gave him the Norman inheritance with the peevish remark that Robert was a 'proud and silly prodigal and will have long to suffer severe misfortune.' He did not care for Robert. England went to William Rufus who was admonished to be less a king than a watchful servant of God. William was a little ashamed of the way in which he had acquired England himself and felt that he should make some amends for his behavior. William Rufus was dispatched to England on the day before his father's death to study under the good Bishop Lanfranc, how to be a good king. What success Lanfranc had in his teaching can be

read in the history of Rufus reign which was of such cruelty and terror as to make William's sins seem lily white.

Henry the third son was given only money. This brought a wall from Henry who said that 5,000 pounds was nothing if he could not have a corner of the earth to call his own. Soothing him, his father predicted that this boy would succeed to all the dominions that were William's and would surpass his brothers in power and wealth. William knew his sons. Robert and William Rufus died as shiftlessly as they had lived. Not the canny Henry was King of England and Lord of half of France before he finished.

William grew no better. The blow from the saddle while it did not rupture the distended sac of one or another of his chronic diverticula evidently caused such injury to the walls that it slowly necrosed. He must have become more and more toxic and the sac more and more inflamed until during the night of the 8 to 9th of September it ruptured at last, and peritonitis intervened.

The end came in the early morning of September 9, 1087. William who for 4 weeks, had rent the air with groans and torn the bed with writhings had spent the previous night in quiet undisturbed slumber. As the sun rose he woke to the sound of bells and in a weak voice asked what they might be. He had become disoriented for they were the same bells he had heard all the weeks that he lay there the bells of the Cathedral of St. Mary in Rouen routinely tolling for primes. William made one more impassioned well-turned speech commending himself and his soul to God the Virgin and Jesus Christ and with dramatic perfection raised his hands to heaven and drew his last breath with his last well chosen word.¹

Hardly had his chest stopped heaving than a great metamorphosis overcame the pious atmosphere of the bed chamber. His devoted watchers picked up their voluminous skirts and vanished all on the same mission. They ran toward their bequests. The body servants stripped the body, searched the room, turned out the bed, and fled leaving the unlamented Duke lying naked on the floor. Henry not too indifferent to his 5,000 pounds, was already on his way to where his money was to be found. Not until 3 hours later

¹Denique quinto idus Septembris, feria vi, Jam Phoebus per orbem spectantis clara radiorum spicula, euctus ex eorum majoris signi auditu in metropolitana basilica. Percutiente eo quid sonaret, responderunt ministri "Domini, hora prima jam pulsatur in ecclesia Sanctae Mariae. Nunc res summa devotione oculos ad coelum erexit, et eorum sonibus extensa, dixit: Domine deus, sanctae Dei genitricis Mariae, nos commendo ut ipsa sanctis precibus me reconciliet carissimo filio tuo Domino nostro, Jesu Christo. Et his dictis protinus exspiravit. Ordericus Vitalis. *Historia Ecclesiastica*. Libri tredecim. Paris, 1845 ed.

REVIEWS OF NEW BOOKS

THE book on *Preoperative and Postoperative Care* written by William J. Tourish and Frederick B. Wagner, Jr. presents the routine and methods used by these men in their surgical practices.

It is very well prepared and will be found an invaluable aid to internes and residents. The procedures given are those followed by the authors but they wisely point out the necessity of being alert for other methods which are equally good and which when found useful should be accepted. While routines are necessary and useful, their maximum benefit is achieved only when each patient is treated as an individual problem, and such changes made as may be necessary for intelligent application of the routines in each specific instance. It has additional merit in that it gives detailed specific measures of examination and all phases of treatment.

The constant observation and treatment both before and after operation are stressed. In difficult and controversial cases the importance of seeking the opinions and advice from an internist and from specialists in other fields is emphasized.

The first two chapters deal with the general preoperative and postoperative care. Chapter III describes the management of specific groups of surgical problems. Chapter V deals with the care of the urological patient, Chapter VI with the neurosurgical patient and the final chapter, Chapter VII, which is very well written, deals with the gynecological patient.

This book will serve as a guide to detailed methods and procedures against which the interne or resident may check his own efforts and add those things which are necessary. R. T. BOTH.

THE monograph *Aspetti di patologia placentare* by Massimo Macciotta presents a very detailed and extremely interesting description of the changes found in the placenta in various diseases of the mother. The diseases considered are the pathological conditions of the kidney due to pregnancy eclampsia, nephritis, syphilis, tuberculosis, infectious diseases, malaria, intrauterine death of the fetus and heart diseases.

In addition to the macroscopic findings, such as hypertrophy of the placenta, variations in consistency, color and weight, and particularly variations in the proportionate weight of fetus and placenta, the microscopic findings are discussed in

PREOPERATIVE AND POSTOPERATIVE CARE. By William J. Tourish, M.D., F.A.C.S. and Frederick B. Wagner, Jr., M.D. Foreword by Thomas A. Shallow, M.D. Philadelphia: F. A. Davis Co. 947.

ASPETTI DI ATOLOGIA PLACENTARE. (Pathology of the placenta.) By Massimo Macciotta. Bologna: Nicola Zanichelli Editore. 947.

cluding the finding of Langhans cells, regressive and proliferative changes in the vessels, various regressive changes in the stroma, the red and white nodules so frequently seen and hemorrhagic foci. The article is profusely illustrated with photomicrographs of the findings, and tables are given showing the percentages of the individual findings in the various diseases.

While there are certain findings which are characteristic, such as the destruction of the amniotic epithelium which is seen almost exclusively in maceration of the fetus, the hypertrophy of the villi and the eccentric endarteritis obliterans of the vessels of the villi, so frequent in syphilis, and the finding of parasites in the red blood cells in 70 per cent of the cases of malaria, there is no picture that is absolutely pathognomonic of any of the diseases in question. But if the different pathological findings are checked with a table of the frequency of their appearance in the different diseases, valuable indications as to diagnosis are given. The monograph is worthy of careful study. AUDREY G. MORAN.

THE second volume in the series of textbooks which is being published under the general heading of *The Rehabilitation of the Injured* has recently appeared. It deals with specific remedial exercises and is not concerned with general exercises, games, and recreational activities which will be included later in a volume on recreational therapy. Passive therapy has not been included as its use in the treatment of traumatic conditions has been described fully in many of the standard textbooks on physical medicine.

Watson Jones in his foreword brings out several good points. The death knell of massage has been sounded. No longer must the patient be lulled to sleep with soothing massage; he must be galvanised into activity by invigorating exercise.

Rehabilitation of the injured begins with surgical and manipulative treatment, which is accompanied and followed by physiotherapy, exercise therapy, occupational therapy and recreational therapy and is completed by retraining and resettlement. The process is involved and prolonged. But two principles may be recognised. The first was known to Galen hundreds of years ago. Confidence and hope do more good than physic; he cures most in whom most are confident. The patient must be encouraged; he must be stimulated; he must be inspired; he must learn that success depends upon his effort alone. But the second principle is equally important. Rehabilitation calls not only for recreation; it calls for work and very hard work.

THE REHABILITATION OF THE INJURED. Vol. Remedial Gymnastics. By John H. C. Colson. Foreword by Sir Rossini Watson-Jones, B.Sc., M.Ch. Orth., F.R.C.S. London: Cassell & Co., Ltd. 947.

The literature of rehabilitation is of two kinds: generalizations and the much more rare utterances of those who know how to do the job and who have the gift of imparting the knowledge to others. The author Mr. Colson is among the latter. This book cannot fail to interest medical men, particularly surgeons and physical medicine specialists. It will be of particular value to physiotherapists whose work is to apply and elaborate the principles underlying exercise therapy.

JOHN S. COVATTA.

THE recent book by Hans May has been called quite appropriately *Reconstructive and Reparative Surgery* since it emphasizes the correction of anatomic defects in all fields of surgery. The basic concept of the book, whether dealing with general principles, with anatomic regions, or with specific problems of repair is that there are but a few fundamentals underlying all surgery. These fundamentals do not change with the particular field of the individual surgeon but are the same whether dealing with the head and neck, the trunk, or the extremities. One is not surprised therefore to find described operative procedures for repair of nonunion of the long bones next to discussion of arterial repair and obliterative aneurysms. Nor should the surgeon be startled to find in what is ostensibly a book on plastic surgery discussion of the repair of incisional abdominal hernia, and anal sphincter defects alongside excellent descriptions of correction of lip and nasal defects, deformities of the ears, eyelids and orbits.

Barrett Brown in his introduction to the volume states that "actual procedures are relatively few and they may be carried from field to field. Actually the principles of plastic surgery are the principles of good surgery whether we deal with general surgery or orthopedics or ophthalmology. To many surgeons it has seemed that the application to surgery in general of certain principles so essential to good results in plastic surgery has been one of the factors which has made for real advancement in the science. It is therefore quite fitting that this book embraces so many of the surgical specialties."

The volume falls into three major parts although the author has made five divisions. The first part deals with the general principles of reconstructive surgery starting with a discussion of preparation of the patient, instrumentarium and the various procedures and techniques common to all types of plastic surgery, and includes chapters on wound healing and the treatment of wounds and burns. The second part of the book, divided into three divisions by Dr. May, covers the plastic and reparative surgery of the various anatomic areas—head and neck, the trunk and the extremities. The third part of the book is devoted to illustrated reports of 135 cases, each carefully chosen to bring out some particular operative procedure or problem.

The volume is most generously illustrated throughout the text by many drawings, photographs and

diagrams of operative procedures. In looking at the excellent illustrations and photographs and reading the text pertaining to them one realizes that they represent the actual experience and considered judgment of the author.

The book contains much of interest to every surgeon. Its range of practical applicability is wide. It should be a welcome addition to that section of a surgeon's library where the volumes are well thumbed since often consulted.

MICHAEL L. MARY.

IN nine hundred odd pages, accompanied by 14 illustrations the author of *Surgery of the Incurable Patient* has completely covered the subject including much material on the diagnosis of conditions requiring hospital care. Despite the fact that division of surgery arbitrarily into ambulatory and hospital practice is an artificial one, this volume is needed for an authoritative reference on either procedure. The decision as to whether a surgeon will treat a patient with a given lesion in a hospital or office will usually depend on the facilities available locally and thus must be made by each surgeon individually. Many of the patients described in this volume are ordinarily considered as hospital cases; surgeons who have sufficient hospital facilities will find this volume valuable.

A comparison of this volume with the first edition shows that the sections on infection have been rewritten to include the use of penicillin, which was available at the time the first edition was published. The section on second degree burns has been completely rewritten, the author now advising several different premature dressings in the treatment. A new section on the truss treatment of inguinal hernia has been added. Considerable new material has been added to the chapter on the back, including a consideration of the herniation of the nucleus pulposus. The treatment of gonorrhea has been rewritten to include the use of penicillin. A new section has been added on tendon suture as well as new illustrations for this section. In addition to the specific lesions mentioned a large number of new references have been added to the previous volume. Some new illustrations have replaced older ones. Enough old material was deleted to prevent any increase in the size of the book. A table of contents and an adequately revised index are included.

THOMAS C. DORRANCE.

A very comprehensive, carefully compiled treatise on *Trichomonas vaginalis* and *Trichomonas* by Ray E. Trussell is presented as a foundation for a constructive study of a perplexing clinical problem. Despite the wealth of literature which has accumulated since Doane first described the organism suggested its clinical importance more than two years ago, many features of human trichomoniasis

SURGERY OF THE AMBULATORY PATIENT, by L. E. Brown, M.D., F.A.C.S., ed. ed. Philadelphia: J. B. Lippincott, 1947.

TRICHOMONAS VAGINALIS AND TRICHOMONAS, by Ray E. Trussell, M.D. With an introduction by E. D. Allen, M.D. Springfield, Illinois: Charles C. Thomas, 1947.

remain almost as obscure as when Hoehne revived interest in the problem in 1916. As the author states in the preface, — the time has come to replace the older investigative technic with the modern physiologic approach. This book provides invaluable reference material for any new approach and as such will be welcomed by research workers as well as by gynecologists and urologists who seek a comprehensive, unbiased treatise on the subject.

The work is divided into three parts. Part I "Trichomonas Vaginalis," deals with the morphological, biological and epidemiological characteristics of the organism. Criteria are given for differentiating trichomonas vaginalis from the morphologically similar but separate species which infect the mouth and the intestinal tract. The taxonomic relationship of trichomonas to other protozoa is explained fully in Appendix A and the complete parasite host list of trichomonads (with original reference to each named species) is given in Appendix B. This material will interest the research worker and parasitologist. Part II, Trichomonas Vaginalis Infections, presents in detail the clinical aspects of the disease in women as well as men. Part III, Treatment, outlines the methods which have been employed in the treatment of human trichomoniasis and lists alphabetically the more than 150 chemicals utilized in efforts to eradicate the parasite giving the results reported for each. An imposing list of 1386 references in the bibliography is proof of the zeal with which the author has undertaken the study. To quote again from the preface: "this volume makes the errors and successes of the past readily available for those who would pursue the problem." HAROLD C. MACK

IN the words of the authors of *Essentials of Pharmacology*¹ "This book is intended to serve as an introductory text in pharmacology. On the other hand the general principles of pharmacology have been stressed wherever possible and efforts have been made to indicate what appear to be the coming trends in the field.

This book is a clear and concise coverage of a very extensive field. It is up to date and mentions most of the drugs developed in recent years. Information is to be found here on such drugs as myxanecan, mesantol, tridione, amldone, dibenamine, disopropyl fluorophosphate, antergan, neoantergan, diphenhydramine, triphenylamine, pteroyl glutamic acid, the nitrogen mustards, British antilewisite, chloroquine, paludrine and pentamidine. In addition some of the older drugs such as urethane, which have been put to new usage, are discussed.

Although no claim is made for this book as an investigator's handbook, still a fairly extensive and pertinent bibliography is included at the end of each section.

Because of its brevity (413 pages) and easy reading style it would seem that this book would serve

ESSENTIALS OF PHARMACOLOGY. By FRANK K. Oldham, M.Sc., Ph.D., F. E. Kelsey Ph.D. and E. M. K. Gellink, Ph.D. M.D. Philadelphia, London, Montreal J. B. Lippincott Co., 947

admirably as a 'refresher' source for the busy practitioner and also as a text for medical students and nurses. CARL A. DRAOSTZDT

IN a well organized and comprehensive monograph² I. Karner and Koletsky have presented the currently accepted teachings concerning the calcific changes which occur in the aortic valve.

By a selective use of the literature and with the addition of 200 of their own cases (only those with autopsies are included) they have arrived at their opinions. The statistical data have been analyzed properly and corrected for factors of error.

As would be expected the stress is on the pathologic changes (macroscopic and microscopic). There are listed the morphologic alterations seen grossly and on histologic study. There is one chapter devoted to the clinical considerations however.

Excellent photographs, photomicrographs, and tables are included.

There is a satisfactory concise historical review which actually indicates the reason for the publication.

They conclude that (1) calcific disease of the aortic valve is largely the result of previous inflammation (principally rheumatic) (2) the entity is most common in white males of the older age groups (3) enlargement (by weight) of the heart occurs in three-fourths of the cases, (4) the electrocardiograms vary widely but are in accord with physical laws and (5) there is only a small factor of error in the x-ray diagnosis of calcification in the aortic region.

This volume is of major interest to internists and pathologists is of value to any physician and surgeon, and should be readily available as a reference to all persons in the field of medicine.

M. C. WHEELLOCK.

THE new *Textbook of the Nervous System*³ by H. Chandler Elliott is designed for medical students and anyone beginning study of the human nervous system from a clinical standpoint. The author realizing the student's necessity for knowing something about the nervous system before studying it in detail presents the story twice. The first 95 pages consist of an abbreviated description of the nervous system's form and function, with numerous simple diagrams for illustration which incidentally throughout the book give the story in themselves. After such a short cut the entire nervous system is considered in the second part more completely and technically.

Here again the author does not use a conventional method of anatomical description but presents as far as possible a functional discussion of the parts of the nervous system in logical sequence combining and

¹"CALCIFIC DISEASE OF THE AORTIC VALVE: A COMPREHENSIVE ANALYTIC SURVEY OF CALCIFIC SCLEROSIS. By Howard T. Karner, M.D. and Simon Koletsky, M.D. Philadelphia, London, Montreal J. B. Lippincott Co., 947.

²"TEXTBOOK OF THE NERVOUS SYSTEM: A FOUNDATION FOR CLINICAL NEUROLOGY. By H. Chandler Elliott, M.A., Ph.D. Philadelphia, London, Montreal J. B. Lippincott Co., 947.

tomical description and analogies and diagrams to aid in the interpretation of the physiology.

The sequence of presentation is from the neuron and its parts through spinal cord and brain stem to the larger gray masses, the autonomic system being presented after consideration of the suprasegmental structures. Considerable space is properly given to functional systems in which there is clinical interest as the auditory, vestibular and gustatory systems and the visual system. A brief appendix lists the meanings of most neurological terms, and a working bibliography is included. An atlas of photographs of actual dissections and stained sections of brains completes the book.

The author's wish to avoid unnecessary anatomical detail has led to the illustrations possessing but

few labels, and the structures he wishes to highlight are thus emphasized, as well as by the simplicity of design of many diagrams. A question might be raised as to whether or not there are enough labels and non-diagrammatic illustrations for the beginning student.

The style is lucid and at times pleasantly repetitive in the use of illustrative analogies. Because of his wish to have the student get a clear working knowledge of the basic brain one can sympathize with if not entirely condone, the author's tendency to grasp firmly one horn of certain dilemmas, while somewhat dogmatic in disputed areas. But references to recent literature are generously given in the text to give authority for statements and encourage reading further.

SAM L. CUM

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE FIRST BOOKS SUPPLEMENT TO THE PHARMACOPOEIA OF THE UNITED STATES OF AMERICA. Approved by authority of the United States Pharmacopoeial Convention. Prepared by the Committee of Revision and Published by the Board of Trustees. Official from July 1, 1944. Easton, Pennsylvania: Mack Printing Co., 1944.

A TEXT BOOK OF PSYCHOLOGY, AN INTRODUCTION TO MEDICINE. By William Boyd, M.D. (Dipl. Psych.) M.R.C.P. (Edin.) F.R.C.P. (Lond.) LL.D. (Sask.) M.D. (Orie.) F.R.S.C. 5th ed. Philadelphia: Lea & Febiger, 1947.

ESSAI DE PATHOLOGIE THYRO-HYPOTHYRAIRE. ETUDES CLINIQUES, THERAPEUTIQUES ET EXPERIMENTALES. By Jacques Mahaux. Paris: Masson & Cie, Editeurs, 1946. Editions Desoer, 1947.

MINOR SURGERY. By Frederick Christopher, M.D., F.A.C.S. 6th ed. Philadelphia and London: W.B. Saunders Co., 1948.

DIABETES MELLITUS IN GENERAL PRACTICE. By John R. Collip, M.D. Chicago: The Year Book Publishers, Inc., 1947.

HAY GROVER'S SYNOPTIC OF SCIENCE. Edited by Sir Cecil P. G. Wakeley, K.B.E., C.B. 15th ed. Baltimore: W. Williams and Wilkins Co., 1947.

A SYNOPTIC OF ANAESTHESIA. By J. Alfred Lee, M.D., S., L.R.C.P., M.M.S.A., D.A. Baltimore: The Williams and Wilkins Co., 1947.

RETROPERINE URETHRY SURGERY. By Terence M. M.A., M.Ch. (Dubl.), F.R.C.S., F.R.C.S.I. Baltimore: The Williams and Wilkins Co., 1947.

EL ESTUO MARIATICO. By Dr. J. Campo Marañón. La Coruña, Spain: Imprenta Editorial Moret.

CISTITIS Y CISTOPATIAS. By Luis Chaves de Dela. Madrid, Spain: Editorial Pax Montalvo.

March, 1948

SURGERY GYNECOLOGY AND OBSTETRICS

Supplement

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EL ESTOMAGO RENEGADO. By Dr. J. Caspary Marichart. La Coruña, Spain: Imprenta-Editorial Moret.

CRISTES Y CISTOPATIAS. By Luis Clemente Delgado. Madrid, Spain: Editorial Paz Montalvo.

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COLLECTIVE REVIEW

CARE OF PATIENTS WITH SURGICAL DISTAL
OF THE CHILI

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There are many nonoperative considerations in the surgery of the thorax which can be neglected only at the cost of a high mortality as well as a high morbidity regardless of the surgeon's technical skill. In recent years important advances have been made in the preparation and after care of the patient. This presentation is a review and evaluation of these agencies. No reference will be made to diagnostic, operative or anesthetic procedures that involve the patient's preoperative or nonoperative treatment.

DISONANTIVE RELAXATION

Feeding and depletion. The preparation of a patient begins when it becomes apparent that he may be a candidate for operation. Any patient who has a malignant neoplasm or a chronic infection may be assumed to have an anemia. As a part of the history, a few pertinent questions relative to dietary habits and food intake can aid in the estimation of degree of subnormal hemoglobin. The obese person should be told that an additional weight is necessary before operation and the thorax can be undertaken with maximum safety. Conversely, such a patient may be hospitalized, and to the person between the two extremes, a still calmer method of treatment, at days or weeks later. In fact, the employment of these means are again a

dietary instructions should be begun at once if there is any indication for their need.

In some diseases there is an optimum time for operation. The wise surgeon, for example, will rarely perform a major operation on a tuberculous patient who has not been under medical observation for at least 6 months. He will be careful to carry out resection for bronchiectasis during a remission when pneumonia and hilar adenopathy are likely to be at a minimum (6). Since the intrabronchial instillation of a fixed oil occasionally produces a fulminating reaction, it is a wise precaution to give a prophylactic pneumonia attack by the oral route a few weeks after the making of a bronchogram (6).

From the work of Blalock, I have read that Elman and others (as) still were skeptical as to much depend on the care without hospitalization prepared for operation. Against this I have written, and I believe I have been able to convince them that the best results are achieved by the use of the hospital. I have also written that the best results are achieved by the use of the hospital. I have also written that the best results are achieved by the use of the hospital.

tion (33) An elderly patient with a history suggesting coronary disease may tolerate the operative procedure of pneumonectomy but he is more apt to develop coronary insufficiency in the first few postoperative days than is the patient with normal coronary arteries, especially if any degree of shock or anoxia should occur during the operation. The diagnosis of congenital cardiac lesions, the preparation for operation of the patient with constrictive pericarditis, and the management of cardiac and renal complications require the close co-operation of the internist. Digitalis, in the absence of congestive failure, is not only unnecessary but probably harmful (38) Patients in whom the cardiovascular tone is poor after months of complete bed rest tolerate major surgery better if they are allowed to sit and walk for from 5 to 20 minutes twice daily for at least a week before operation.

Respiratory function is of great importance in thoracic surgery. Vital capacity is still commonly measured preoperatively but since it represents only one component of the ventilatory function and is subject to so many variables it is useful only in the broadest sense (4) In young patients lobectomy is usually followed by little appreciable reduction of the respiratory reserve. Indeed, the disease itself is more dangerous than operation or the possible loss of a little respiratory reserve. In the older patient who has a bronchial or pulmonary neoplasm the prognosis is so poor if resection is not done that considerable leeway in the matter of functional risk should be assumed. A rough clinical estimate of respiratory function can be arrived at by the correlation of roentgenographic findings with the efficiency of diaphragm and rib movements, studied fluoroscopically. In the roentgenogram, evidence of pleural damage, widespread nodular lesions, and emphysema are of considerable significance. At the fluoroscopic examination, if the free excursion of the diaphragm is limited for any reason, there is undoubtedly a decrease in its ventilatory power and consequently in the respiratory function. The response of pulse and respirations to the performance of some simple task, such as climbing a flight of stairs, has great practical application but alone cannot, of course, be expected to gauge respiratory function.

Spirometric and bronchospirometric determinations, however, are often of great assistance in the detection of the degree of functional impairment produced by discrete nodular scars or other pulmonary infiltrations, emphysema, pleural adhesions and previous collapse therapy (28) Recent observations by Levy, Seabury and Hull

indicate that there are often remarkable discrepancies between the respiratory function (ventilatory and respiratory components) as estimated from data on patients' records, and that revealed by laboratory determinations. They conclude

Without bronchspirometric studies one cannot properly appraise the percentage distribution of pulmonary function even when the complete clinical picture, radiological data, and vital capacity are taken into consideration. Information, not otherwise obtainable, is gained with sufficient frequency to justify the expense, time, and risks entailed.

Prophylaxis One of the more important aims of preoperative preparation is the elimination of sources of infection in the upper as well as the lower respiratory tract. The grosser aspects of oral sepsis should be remedied by a dentist before any intrathoracic operation. Major surgery of the paranasal sinuses, however, is of more lasting benefit if it is postponed until at least several months after the elimination of suppurative pulmonary disease (47-76)

In any disease characterized by pulmonary suppuration postural drainage is a fundamental treatment even when operation is not possible. It is essential for preoperative preparation and if the best results are to be obtained it must be used thoroughly and frequently. Its effects may be greatly enhanced by one or more painstaking bronchoscopic aspirations. On the morning of operation tuberculous as well as nontuberculous patients should have a thorough postural drainage. The inhalation of steam is often a valuable adjunct to posture. Beecher feels that postural drainage should not be done within 2 hours of operation because the patient's continued coughing may hinder induction of anesthesia (15) Bronchoscopic aspiration is usually not done on the morning of operation. Nevertheless, this may be advisable if the effort required to raise large amounts of sputum is tiring to the patient or if after postural drainage his cough and respirations continue to sound moist.

In many patients with bronchiectasis the administration of penicillin produces marked change in the sputum. The bronchopulmonary secretions decrease in amount, become less purulent and often lose their offensive odor. Occasionally when gram positive cocci predominate the sputum practically ceases after 4 or 5 days of penicillin therapy (68-69-81-50) Penicillin alone has certain inadequacies. It has no significant effect on most gram negative bacilli and with the disappearance of the cocci from the sputum the bacilli appear or increase in number (50-81) These organisms have been found to grow luxuri-

the procedure. Tuberculosis, for instance, may not be suspected, but a series of examinations of the sputum concentrate should be done routinely. From time to time the unexpected finding of acid fast bacilli clarifies a doubtful diagnosis or demonstrates that tuberculosis coexists with some other pulmonary lesion. This discovery except in the presence of a neoplasm, would be very likely to affect the decision in regard to treatment. Whatever the etiology of the disease may be, if the patient raises sputum, its daily amount should be recorded, preferably in grams, for serial comparison.

In addition to routine blood and urine examinations, determination of the type and Rh factor of the blood must be done. Abbott (12) has emphasized the fact that the concentrations of the constituents of the blood show a surprising variability which depends on the plasma volume. The proteins of the plasma roughly mirror the state of the other body proteins in the proportion of about 1 to 30 (36) but in states of chronic malnutrition (as in a patient with esophageal obstruction), when body proteins are diminished the blood volume itself is often reduced (37)—perhaps in an attempt to retain a favorable concentration of plasma protein. A severe anemia may also be present, but due to the masking effect of a decreased plasma volume, the protein concentration, red cell count, hemoglobin, and hematocrit may all deceptively appear to be normal. A simple means of ascertaining plasma volume would doubtless become a great asset. Obviously no single test is absolutely trustworthy when it is considered apart from others or without regard to the history and clinical appearance of the patient (12).

When the patient is admitted, he should be given a high protein, high carbohydrate diet. If depletion is severe, as it is apt to be in carcinoma of the esophagus, some days or weeks may be necessary to overcome it sufficiently to make operation reasonably safe. Varco has demonstrated that anyone who can take fluids orally can ingest more than 8,000 calories per day without discomfort (91). He feels that patients should be carefully prepared for from 5 to 7 days for each 10 per cent of body weight which they have lost. For those who are completely obstructed intravenous feedings are advisable although the intake of both glucose and protein hydrolyzate may be limited by the amount of fluid which can be administered safely. In such cases the advisability of a jejunostomy or gastrostomy should be considered (85).

Not only the blood volume but the red cell mass has a relation to the early onset of surgical

shock (37). A deficiency of the latter can be corrected only by transfusions of whole blood. Early correction of a severe or prolonged anemia may result in a feeling of security which is not justified. Not only has the circulatory system become accommodated to the decreased volume but the heart may have suffered some damage. To increase the blood volume rapidly imposes new work on the injured myocardium before it has had an opportunity to recuperate. Large transfusions given frequently are apt to produce pulmonary edema or cardiac failure. Small transfusions every 1 to 3 days over a period of 1 to 3 weeks, if necessary, are probably safer. While it is possible and sometimes necessary, to give a low type O blood to a patient of another type, it is obviously better to use only homologous blood. If negative blood may be given safely to Rh positive persons, but the reverse may not be undertaken without the risk of stimulating the production of an anti-Rh agglutinin in the blood of the recipient (68).

The need for adequate reserves of ascorbic acid for satisfactory wound healing is well known (5, 59, 62, 98, 97). The debility of a wound following pulmonary resection, or the opening of a bronchial stump or an esophageal anastomosis is a catastrophe which may be fatal. The bone, blood, and urine levels of ascorbic acid are disturbed by anesthesia (17) and operation. Injured tissue immediately demands large amounts of ascorbic acid (97) and, if the reserves are low, the remainder of the body is depleted in the absence of adequate intake. Lund (61) has found that a daily intake of 2 grams is necessary to maintain a relatively normal blood level in some extremely burned patients. In general, it is not necessary to carry out elaborate saturation tests. It is simply to assume that the average patient is deficient and to give him at least 1 gram (98) per day for several days before operation. With regard to the other vitamins, it has been recently suggested (59) that the severely ill surgical patient may need more of these substances than was previously supposed (51). Levinson *et al.* recommended, in addition to 1 gram of ascorbic acid, 50 milligrams of thiamin, 50 milligrams of riboflavin, and 500 milligrams of nicotinic acid daily for several days before and after operation.

The surgeon usually relies on the interest in doubtful cases to estimate the status of the heart and kidneys. In young persons, well compensated valvular lesions do not add greatly to the operative risk (38). Congestive failure, coronary disease, and syphilitic aortitis, however, create a considerable hazard to the performance of any opera-

necessity for such co-operation as he may be able to give postoperatively he is ready for operation

CARE OF THE PATIENT DURING OPERATION

The proper management of a surgical patient is the continuous application of functional principles this is particularly important during the relatively brief period of the operation, when new and powerful factors are being introduced. The immediate preoperative routine need not differ from that generally used before any major operation under inhalation anesthesia. A mild sedative is usually given the night before operation and often repeated in the morning except for this, nothing should be given by mouth after midnight. Reference has already been made to the preoperative evacuation of pulmonary secretions. Operations which can be performed under local anesthesia e.g., minor procedures for tuberculosis or the drainage of empyema and lung abscess, require in addition only codeine or morphine as premedication. Either ether or cyclopropane, in closed circuit, is used successfully in thoracic surgery. Each has certain disadvantages which its proponents are inclined to minimize. More important considerations than the agent itself are (1) a smooth induction (2) an adequate airway with a high proportion of oxygen in the mixture of anesthesia gases (3) a moderately deep plane, with attention on the part of the anesthetist to dangerous reflexes which may be produced by the surgeon and (4) the scrupulous cleansing of the tracheobronchial tree as soon as moisture is detected.

The use of an intratracheal tube is rarely necessary for thoracoplasty but a tube should be employed in any major intrathoracic operation when the patient is more than 10 years of age. At the University of Michigan Hospital it is seldom used in younger or undersized children because of their increased liability to laryngeal edema, although in some clinics tracheal intubation is practiced almost routinely in children of any age, for any thoracic operation. No rigid rule however can be adopted since circumstances may be such that the acceptance of the possibility of laryngeal edema and the performance of an immediate tracheotomy may be preferable to omission of the tube. The presence of such a tube affords the anesthetist complete control of the anesthesia and the respirations, even in the event of a bilateral pneumothorax it prevents the interference of adducted vocal cords with respiratory exchange and gives ready access to potentially dangerous bronchopulmonary secretions. While an inflatable cuff makes the system absolutely gas

tight it has the disadvantage of being relatively difficult to insert and occasionally is responsible for serious and even fatal complications. If the proper size of Magill tube is chosen, the anesthetist will have little difficulty with leakage. The latter can be controlled, if necessary by the use of a face mask over the patient's nose and mouth, and the open end of the intratracheal tube, or by a pharyngeal pack. In adults the tube is more easily inserted under local than under general anesthesia. The pharynx larynx and trachea are prepared as for bronchoscopy while the patient sits upright on the side of the table. The lubricated tube is then passed with the aid of a metal stylette and a laryngeal mirror after which the patient is placed in the supine position and the tube is immediately connected with the machine and strapped in place with adhesive. The person who passes the tube should ascertain from its length how far it must be inserted so that the end will lie not less than 2 centimeters above the main canna, the position of which is marked externally by the second costal cartilage. Maier (65) warns against the use of too small a catheter for aspiration through the intratracheal tube. One that may be adequate for the removal of thin secretions may not be large enough to aspirate the thicker material expressed by the collapse or manipulation of diseased pulmonary tissue. A number 16 F catheter with its end cut off squarely or obliquely should be adequate for use within a large Magill tube, but smaller sizes of the latter necessitate correspondingly smaller aspiration catheters. After the induction the patient is placed in position and securely braced and strapped. If the thoracoplasty position is used the dependent leg is flexed the weight of the uppermost leg which remains straight, can be supported by a pad so that it will not interfere with the flow of fluids into the opposite long saphenous vein at the ankle. A cannula or large needle is inserted into the saphenous vein and the administration of a solution of 5 per cent glucose begun at once. The peripheral veins may be so contracted in shock that fluids will not flow by gravity. Since it is usually necessary at such times to give blood rapidly in large amounts a three way stopcock and a 20 or 50 cubic centimeter Luer syringe should be available to insert into this system. The table should be tipped until the patient is in a 15 degree Trendelenburg position.

It is of great importance for the surgeon and the anesthetist to understand one another's difficulties (65). On the one hand the surgeon's patience during induction or his failure to pause should the plane of anesthesia become too shallow

cubic centimeters of blood mixed with the same amount of saline solution carries into the vascular system almost 30 grams of sodium chloride (82). It is especially important to dilute blood given to infants with as little saline solution as possible, since many become edematous when the operation precludes feeding for the first few days after operation. On the whole, in view of the fact that there is no need for the extra sodium, it is probably better not to use isotonic saline solution, even though it is the most satisfactory diluent for blood.

It is very difficult to estimate blood loss clinically. Indeed shock may occur before the surgeon realizes the magnitude of the loss. Wangenstein (93, 14) has developed a simple gravimetric method by which blood loss is serially determined throughout the operation. Only dry gauze sponges or packs of standard weight are used to remove blood from the operative field. These are carefully collected as they are used and are weighed at frequent intervals on a balance accurate to 1 gram. Each gram gained by the sponges is assumed to represent 1 cubic centimeter of blood. Since the specific gravity of blood is greater than 1, the calculation is not strictly accurate but the error is negligible and is more than compensated for by the inclusion of fluids from serous membranes. In fact the authors suggest the subtraction of 10 per cent to correct for such fluids. While this method is obviously not exact it seems to be of considerable practical value in that it gives a better continuous estimate than has ever been available before. The operative field can be washed with cleansing or antiseptic fluids after the free blood and clots have been removed for weighing. Warm moist packs, with any blood they contain are simply not weighed.

When that part of the operation associated with bleeding has been completed and the necessary blood has been given, a 5 per cent solution of glucose may then be given. This should not be allowed to flow rapidly since the lowering of the plasma protein concentration which occurs when fluids are rapidly administered intravenously predisposes toward pulmonary edema by lowering the colloid osmotic pressure of the blood as well as by increasing the blood volume (40). This is particularly important during and after pneumonectomy when the entire cardiac output must suddenly be forced through the vascular bed of the remaining lung. Altshuler *et al* have shown that the total capacity and its components are slightly reduced (9.6 per cent) even in normal persons, large infusions given intravenously at rates of more than 30 drops per minute. The pulmonary villary bed is voluminous and can accommodate

considerable overdilatation at some cost to the intra-alveolar space. However patients with pulmonary disease who are undergoing drastic reduction of pulmonary tissue by resection or collapse, under an inhalation anesthetic, should not be subjected to even the slightest avoidable increase in the distention of this elastic system. When its capacity is finally exceeded and the hydrostatic pressure in the pulmonary capillaries surpasses the colloid osmotic pressure of the plasma, pulmonary edema occurs suddenly. Cournaud and Berry (27) state that the most important cause of early death following pneumonectomy is the failure of proper hemodynamic adjustment to take place. Strains produced by dilution of the blood and overfilling of the vascular system, caused either by rapidly given infusions or by gross overtransfusion within a short period (39) may prevent this adjustment. The slow intravenous flow of glucose solution may be allowed to continue for several hours after operation until a total of from 3,000 to 5,000 cubic centimeters of fluid, not including blood has been given. As has been intimated the use of isotonic saline solution beyond the optional amount for dilution of blood is inadvisable in view of the decreased postoperative excretion of sodium by the kidneys.

The usefulness of penicillin in the pleural space has been amply demonstrated (3, 74, 90, 94, 96). The ability of this drug occasionally to sterilize even an established empyema, which is caused by penicillin sensitive organisms, can no longer be doubted. Since pleural complications following open chest operations are with few exceptions, due to gram positive cocci, there is considerable reason for and none against, its routine use in large amounts whenever the pleura is opened. From 200,000 to 400,000 units in distilled water can be left in the pleural space or injected after the aspiration of the residual air through a catheter left in the wound for that purpose during its closure.

Most surgeons do not drain the pleural space after pneumonectomy preferring rather to retain the fluid (which later becomes an organized exudate) as a space filling medium and to adjust the mediastinal position by thoracentesis. This also has the advantages of allowing high concentrations of penicillin and of avoiding the introduction of bacteria by way of a drain. After lobectomy early expansion of the remaining lobe to cover the hilum of the resected lobe and to obliterate the empty part of the pleural space as soon as possible is desired. Because of the danger of contamination and the obvious difficulties of thor

for certain manipulations, is dangerous. On the other hand, the anesthetist's unfamiliarity with the mechanics and procedure of the operation, failure to keep the airway free of secretions, to prevent anoxia, and to discuss with the surgeon the patient's condition or details of blood loss and fluid replacement can be even more disastrous. At 20 or 30 minute intervals, at phases of the operation when temporary interruption is feasible, and only after aspiration if there is any hint of moisture, the pressure in the anesthesia system should be increased by the gradual application of positive pressure until the lungs are moderately inflated, the mediastinum thus being returned toward its normal position (15). This pressure should not exceed from 10 (65) to 15 (55) centimeters of water. If the system has no manometer the anesthetist must be guided by instructions from the surgeon, who has the lung under his direct observation. Once the desired degree of moderate inflation is attained it should be very gradually released (15). Manual pressure on the breathing bag is usually not only unnecessary but inadvisable since dangerously high intrabronchial pressures, the effects of which are well known, can be unintentionally produced (5).

Vagal reflexes can often be prevented or abolished by the injection of the vagus nerve with procaine solution or by dividing it below the origin of its recurrent laryngeal branch. Injection of the peribronchial tissues may prevent afferent impulses produced by manipulation in this region. Even though peribronchial injection may not be deemed necessary for this purpose (18) it produces no damage and may be of assistance as a mechanical aid to dissection by distending the tissues.

Distortion of the mediastinum such as occurs when the lung or a mediastinal tumor is being pulled upon is well known to produce lowering of the blood pressure by mechanical or reflex action (18). When this occurs it is important to interrupt the traction temporarily. The motion of the diaphragm can be stilled by injection or crushing of the phrenic nerve. This has been objected to on the grounds that an active diaphragm is of importance in aiding the postoperative expansion of the upper lobe following lower lobe lobectomy (47-55). Most surgeons believe that a temporary paralysis, produced by crushing the nerve at operation or within the first postoperative week, is desirable to assist in the obliteration of the space left by lower lobe lobectomy. Paralysis of the diaphragm during pneumonectomy may make the operation easier and reduce the volume of the space to be filled postoperatively the paradoxical

motion which ensues, however transient, from the air or fluid of the closed space a protruding movement to a labile mediastinum which may be harmful (53).

Except for the prevention of anoxia, which is of more immediate importance in the open care of the patient than blood loss and its replacement. It is obvious that any consideration of blood loss is meaningless unless size (body weight) is taken into account (26). For example, a loss of 200 cubic centimeters amounts to 2.4 per cent of the total blood volume of the average sized adult. This is relatively trivial, whereas in a 40 pound child 200 cubic centimeters is 10 per cent of the blood volume. The amount to replace blood, volume for volume, as it is (26-29-80). It is also important during and immediately after pneumonectomy not to give more blood than has been lost (39). Insofar as this can be determined. Dangerous strains on the body's homeostatic mechanism are thus mitigated, and convalescence will be shortened. White and Linton (95) reported 1,607.5 cubic centimeters as the average blood loss for 10 lobectomies and 1,431 cubic centimeters for 6 pneumonectomies. Sir Baronofsky *et al.* found a total average of 1,200 cubic centimeters for 14 lobectomies and pneumonectomies. An extensive revision or Shiel thoracoplasty can scarcely be performed with a loss of 1,000 cubic centimeters, and may involve much more. The surgeon thus has a fair knowledge of the average loss which he may have should not embark on a major operation when the estimated amount being immediately replaceable. If he proposes to remove a small, atelectatic lobe which has been the seat of bronchiectasis in some years and in which repeated attacks of pneumonitis may have produced dense adhesions, he can expect much greater than the average loss of blood. Since the largest loss usually occurs within the first hour and a half, blood should be started at or even before the time when the decision is made. In the event of unexpected, sudden massive blood loss there is no contradiction to the rapid administration of blood with a syringe and three way stopcock interposed in the intravenous system until restoration of the approximate amount lost has been effected. The lives of many war casualties were undoubtedly saved by large amounts of blood and plasma given by this means.

The viscosity of whole blood may be decreased by dilution with a third, a half, or an equal volume of isotonic saline solution. There is, however, no need for the replacement of sodium, and it should be remembered that the administration of 1,000

removed. In pneumonectomy it is desirable only to prevent displacement of the mediastinum from its position near the midline. The pressure in the air-filled hemithorax should be measured with a pneumothorax apparatus as soon as the patient can be safely placed on his back. If the inspiratory and expiratory pressures vary much from approximately 14 to 0 centimeters of water they should be readjusted by aspiration or injection of the necessary amount of air.

The leveling of the table and movement of the patient onto his back or into his bed tend to redistribute the blood volume. This may temporarily simulate blood loss and impending shock can be precipitated unless changes of position are effected very gradually (15).

The removal of the intratracheal tube should be preceded by thorough aspiration of secretions, first from the oropharyngeal and nasal cavities and then by means of a catheter in the intratracheal tube from the tracheobronchial tree. With few exceptions, however, bronchoscopic aspiration of the bronchial passages should also be done after pulmonary resection and after any operation when the respirations sound wet. Even after the most thorough preliminary aspiration by means of a catheter introduced through the intratracheal tube it is not uncommon to discover shortly afterward, on bronchoscopic visualization, secretions or clots in the lobar orifices of the dependent lung. The effect of such secretions is often demonstrable when films made directly after operation show surprisingly large areas of atelectasis in the lung of the nonoperated side. If bronchoscopic aspiration is to be done the plane of anesthesia should be deepened somewhat before the intratracheal tube is removed, not only for ease in the introduction of the bronchoscope but for safety (16). Death due to cardiac arrest has followed more than once the performance of bronchoscopy in a patient under light general anesthesia (70). Some authors even advocate the intravenous injection of 0.8 milligram of atropine sulfate (grains 1/75) from 10 to 15 minutes beforehand (16) as an added attraction.

A film of the chest made while the patient is still on the table is useful in showing the degree of inflation of the lung and the position of the mediastinum, as a check upon percussion and auscultatory findings. Should decostalization in any operation, for example an anterior thoracoplasty have left an area of thoracic wall without bony support so that respiration or cough produces paradoxical motion the dressing should include sufficient packing and should be applied with sufficient firmness to reduce such motion to

a minimum as well as to increase the desired collapse of the lung or pleural space.

CARE OF THE PATIENT AFTER OPERATION

The postoperative occurrence of anoxia is probably underestimated in thoracic patients because neither dyspnea nor cyanosis is a reliable indication of any but great oxygen want (66, 55). Oxygen should be used after thoracoplasty if the patient has a low respiratory reserve and of course, if cyanosis, shock or tachycardia is present or if the patient exhibits other clinical evidence of anoxia such as headache, restlessness, or confusion. It should be administered to all patients who have had pulmonary resection. The patient who has had a pneumonectomy should be returned to his room breathing oxygen through the mask of the anesthesia machine.

Oxygen equipment should be ready for immediate use in the patient's room. A mask such as the Boothby Lovelace-Bulbunan is rarely necessary and has some disadvantages. A nasal tube also possesses some drawbacks but is a relatively simple device which can be counted on to deliver up to 40 per cent oxygen in the inspired air. The irritating action of the tube can be minimized with an emollient and the dryness of the oxygen must be mitigated by passing it through water. Unnecessarily prolonged use of oxygen is to be avoided (55). It does not relieve all types of dyspnea, it thickens the bronchial secretions by its drying action, it can act as a respiratory irritant (55) and its administration may make adequate care and early mobilization of the patient difficult. The use of oxygen can usually be discontinued safely from 18 to 36 hours after lobectomy but it should be kept at the bedside and used again in the event of any complication. An incompletely expanded lobe is somewhat like an atelectatic lobe; there is a discrepancy between ventilation and circulation, the mixed arterial blood having an oxygen saturation which is lower than normal. Some of the clinical signs of oxygen deficiency have already been mentioned but, according to Maier and Courmand (66) and others (55) the only completely reliable guide to the degree of oxygenation of the blood is the determination of arterial oxygen saturation. The continuance of oxygen therapy for as long as 48 hours, or more, is often advisable after pneumonectomy because of the extensive adjustments needed to re-establish cardiopulmonary balance.

Oxygen is only rarely necessary following such intrathoracic operations as the removal of a mediastinal tumor when the patient has no pulmonary disease provided that operative shock

acutestis most surgeons prefer to drain the space for at least 48 hours. A number 28 F mushroom catheter from which the distal half of the mushroom has been trimmed away to leave a flange is conveniently placed through an intercostal stab wound one or two interspaces below the incision at the posterior axillary line. The catheter ends dependently with the usual water seal. It should be clamped near the chest for at least 4 hours after operation to avoid immediate loss of the penicillin solution. White (94) has suggested an ingenious modification of this standard drainage. An intercostal catheter is clamped and incorporated in the dressing. Each day the accumulated fluid is removed and penicillin injected through the tube with aseptic technique. The catheter is withdrawn between the third and fifth days and further collections of fluid are removed by thoracentesis. Using this method he has had only 2 empyemas after 36 lobectomies, in both of which bronchial fistulas were also present. These occurred after extensive resection which left a large dead space that could not be obliterated because of the limiting adherence of the remaining pulmonary tissue.

Intrathoracic procedures which do not involve the esophagus or the lung are generally followed by closure without drainage. Fluid in varying amounts always accumulates after operation and is easily removed by thoracentesis. The pleural or extrapleural space should be kept as dry as possible. When a pneumonotomy is done for drainage of a tuberculous or other type of abscess, the cavity is snugly packed with narrow gauze which although it is ultimately replaced by a large tube need not be changed for the first 3 postoperative days.

The type of drainage required for empyema depends upon the size of the space and the mobility of the lung and mediastinum. It is safe to assume that most nontuberculous pleural abscesses need drainage by rib resection. A small inelastic space may be handled safely by wide incision and gauze packing. Large spaces, however, should be drained by a large tube ($\frac{1}{2}$ inch inner diameter by $\frac{3}{4}$ inch thickness of wall) of gum rubber. To be airtight the tube must fit snugly in the incision through the deep layer of the pericostum and parietal pleura. Vaseline gauze is usually packed between the tube and the extracostal muscles and the outer end of the tube is closed by a water seal. The tube is fixed in position by adhesive strips passed through a safety pin in its wall at the level of the skin. Johnson (54) has suggested an airtight dressing which is effective even over large openings when suction is to be applied. This con-

sists essentially of a rubber glove from which the fingers have been cut off, and which is split along the ulnar side. The drainage tube is inserted through the tip of the thumb and the resulting large square, trimmed to appropriate size, is applied to the operative defect with waterproof adhesive, the thumb sheathing the tube closely. Water sealed drainage tubes, while not always necessary for safety in limiting the respiratory variations of intrathoracic pressure, encourage expansion of the lung by the negative pressure created within the system by the dependent column of water. In addition, the tube provides a neat mechanism for removing irritating and odorous exudates from the neighborhood of the wound.

The healing of a wound is related not only to the body protein (88, 73) and ascorbic acid reserves (97) but also to certain technical details which are too well recognized to need discussion. In the closure of an open chest, however, there are several points worthy of attention. Johnson (5) has suggested the crushing of several intercostal nerves near the spine, above and below the incision, to minimize postoperative pain. Except its posterior portion the wound should then be anesthetized. Annoying paresthesias and weakness of the upper abdominal muscles anterolaterally for several months after operation occur in the crushing of 4 or 5 intercostal nerves, especially those below the seventh. The nerve corresponding to the incision and the ones immediately above and below it may with advantage be infiltrated with a solution of some local anesthetic just before closure of the wound. Although the effect of this anesthesia is likely to last less than 24 hours, external injections can be repeated at will during the immediate postoperative course.

The incision of the parietal pleura and pericostum, or intercostal muscles, can be closed with or without pericostal sutures. Since an intercostal closure is weaker than a closure utilizing pericostum, the former can be supplemented by a few pericostal sutures placed around adjacent ribs beneath the pericostum (70). A careful closure of the deeper layers may occasionally be followed by massive subcutaneous emphysema (63). Delaying the closure of the thoracic wall the lung or remaining pulmonary tissue should not be fully inflated lest it be torn by the needle. Expansion can be more safely obtained and the amount of air entrapped within the pleural cavity rapidly regulated by the temporary inclusion in the wound of a catheter through which, after approximation of the extracostal muscles, the remaining air can be aspirated following lobectomy and the catheter

and should never be neglected. It must be performed at least once daily however to have much significance. Rales, rhonchi clicks and wheezes are best heard during and immediately after coughing. It is often possible to determine quickly the position of the mediastinum the presence of a pneumothorax or consolidation or the presence or absence of breath sounds or pleural fluid.

The parenteral administration of fluid is seldom important in the thoracic patient after the first 12 to 24 hours, since most patients are able to take fluids orally. A full diet should be resumed as soon as possible. In the average adult who has no renal disease the route of administration and the exact amount of fluid given are of less importance than the maintenance of a minimal daily urinary volume of 1,200 to 1,500 cubic centimeters. Diseased kidneys may require a much larger urinary output to carry off the products of metabolism and the range of sodium adjustment is apt to be considerably narrowed. If the sodium intake is rigidly curtailed fluid in large quantities can usually be given orally without danger.

An operation on the esophagus may occasionally require that nothing be taken by mouth for as long as a week. It is essential in such a case to furnish by the intravenous route not only enough fluid to produce a satisfactory urinary volume but to supply at least 200 grams of glucose daily and as much nitrogen in an assimilable form as possible. Cutting and Cutter have shown that in normal subjects the lapse of only 48 hours without food can produce a lowering of the total circulating plasma protein from 170.7 grams to 156.5 grams (8.3 per cent) even though the concentration may remain unchanged. In addition extensive surgical procedures themselves cause a negative nitrogen balance which may last many days.

It is difficult to realize the overwhelming burden which can be placed for a few days postoperatively upon the body's protein economy by the combined effects of chronic disease incomplete repletion before operation and operative blood loss. To these are often added the results of days of partial starvation and the variable loss of fluid containing both protein and red cells into the pleural space. Unless these effects are partially counteracted convalescence will be hazardous and prolonged. Elman recommends that not a single day be allowed to pass without furnishing glucose with nitrogen in the form of protein hydrolysate. This is a more efficient and economic way of furnishing the raw materials for protein synthesis than the use of plasma. Two liters per day of 5 per cent amigen in 10 per cent glucose solution furnish 100 grams of amino acids, 200 grams of glu-

cose and 5 grams of sodium chloride. Elman stresses the fact that amigen should be handled and given with more care than is customarily accorded to intravenous solutions since it is an ideal culture medium for the growth of bacteria. Even when it is given at speeds of less than 500 cubic centimeters per hour unpleasant reactions may occur unpredictably. One of the offending components is probably glutamic acid (79). The occurrence of any suggestive allergic reaction is regarded as a contraindication to the further use of the protein hydrolysate (36).

The fluid which accumulates in the pleural or wound space postoperatively or which is carried off by a drainage tube or by thoracentesis, is only slightly less rich in protein and often in red cells, than is the blood itself (6). Its loss differs from hemorrhage only in that it occurs over a period of days rather than hours (89). Indeed, it is a sort of slow plasmapheresis with the additional loss of red cells. Since this drainage takes place slowly the body with its various restorative mechanisms is usually able to adjust itself to the loss. But poor wound healing, weakness, and greater liability to infection are likely to occur if it goes unrepaired (52-99). The total average loss of bloody serum in Thornton's series of 12 consecutive lobectomies was found to be 673.3 cubic centimeters. The hemoglobin content of such fluid may be as high as from 6 to 8 grams per cent (87). The concentration of the plasma proteins fell 1 gram per cent between the third and fifth postoperative days (89) with similar decreases in the hematocrit value, hemoglobin level and red cell count. Thomas, Adams, and Thornton studied 19 patients who had had major thoracic operations. The average postoperative lowering of hemoglobin was 2.1 grams per cent, most of which occurred between the third and seventh days. The normal person who suffers an experimental loss of from 15 to 20 per cent of his blood volume, restores his plasma protein concentration to a normal figure within 72 hours because he has adequate reserves of body protein (34). In these 19 patients, however the plasma proteins returned to the preoperative level only after 9 days. At the end of from 7 to 12 days postoperatively the red cell volume was still less than the preoperative value by from 208 to 914 cubic centimeters. The obvious answer to such insidious blood loss is transfusion controlled by accurate determinations of red cells, hemoglobin and hematocrit (87) at 2 day intervals for the first 6 or 8 days after operation.

The status of the lungs, mediastinum and pleural and extrapleural spaces can be followed accurately only by films or by fluoroscopy. If a

did not occur and the lung was completely expanded at the end of the operation. Such a patient does not need the Trendelenburg position as a rule. For unconscious patients, however, who have undergone a long major operation the Trendelenburg position has several advantages. Venous return is encouraged and bronchopulmonary and pharyngeal secretions, as well as vomitus, drain toward the mouth. In addition to having the bed inclined from 10 to 15 degrees, patients who have had a thoracoplasty or intrathoracic operation should be placed on the side which was operated upon and should spend most of their time there except for the periodic changes in position already discussed.

It is essential that a competent nurse be at or near the bedside for the first few postoperative hours. The blood pressure and pulse must be followed closely and the pharynx aspirated when necessary. As soon as the patient is conscious he should be instructed to cough. Manual support in the region of the wound is of great assistance to him at this time. When the blood pressure has become stabilized at a normal level and the patient is fully awake, he is more comfortable lying flat than with his head down. For aid in raising his sputum he may be assisted to a sitting position for a few moments, since patients often seem better able to "reach" their secretions when they are sitting erect than when they are recumbent. The importance of keeping the tracheobronchial tree free of secretions cannot be overemphasized. While the patient should spend most of his time on the side of the operation, at hourly intervals he should be turned on his good side and told to cough, even though his respirations may sound dry. The slightest evidence of bronchial moisture is the signal for an attempt to evacuate the offending secretions.

Carbon dioxide is a liquefying agent which reaches the smaller bronchioles and is of great value in loosening secretions there both by its solvent action and by the hyperventilation it induces. The iodide expectorants and steam apparently produce an increase in the output of respiratory tract fluid (23) but this is said to be largely from the major bronchi rather than from the finer ramifications where the secretions are viscid (48). Holinger recommends the addition of steam when ever oxygen is used in order to counteract its drying antexpectorant effect on the respiratory mucosa (48). A constant temperature bath for oxygen humidifiers would be of considerable advantage if it were available. Certainly of the common expectorants, carbon dioxide and steam are the most useful, the former should always be used to the point of moderate hyperventilation

before the patient coughs, at intervals of not more than 2 hours the first few days after operation.

A considerable proportion of the success in meticulous postoperative care of the patient can be carried out by the surgical staff. If it is known, for instance, that pain makes the patient reluctant with a splinted hemothorax and a suppressive cough (24) moderate doses of a narcotic may enable him to extract the maximum efficiency in his cough by dulling its acute pain factors. For all narcotics depress respiration to some degree they must be used with caution. Morphine is safe in doses of from 8 or 10 milligrams at 4 to 6 intervals is better than larger doses at 4 to 6 periods. If the patient has a marked decrease in respiratory function, demerol or codeine should be employed rather than morphine, for neither is of pain. The injection of several alcohol nerves posteriorly, above and below the incision with a local anesthetic solution may afford lasting relief for an indefinite period and can be repeated when necessary (24). If the sequence of pain-spasm-cough suppression is not broken, the postoperative "wet lung syndrome" is likely to develop.

There are other factors besides pain which prevent the effective raising of secretions. Primary emphysema, a paralyzed hemidiaphragm, a large drainage tube, partial obstruction of a part of the lower respiratory tract, bronchiectasis or bronchocutaneous fistula—all may help not to the cough of its effective propulsive power. If the remaining lobe on the side of the lobectomy contains residual bronchiectatic tissue, the difficulties of keeping its bronchial system free of secretions are further accentuated. Such a lobe is, as Miller (49) has pointed out, more likely to develop atelectasis than is one which has no bronchiectasis. Temporary clamping of a drainage tube, especially if it is large, adds greatly to the force of a cough. If the patient is unable to raise his secretions, and he is unwilling to try catheter aspiration of the tracheobronchial tree should be done (49) as repeated as often as secretions reaccumulate. It is rarely impossible to pass a catheter through the nose into the trachea, but even though it can be done with ease, if there is any doubt as to the complete removal of secretions or if some complication such as atelectasis should develop, it is better to examine the tracheobronchial tree bronchoscopically and aspirate under direct vision. This can be performed with surprising ease, without moving the patient from his bed, after brief anesthesia of the pharynx and larynx.

A brief physical examination of the chest can provide information which is often indispensable

sooner operative risk. Overholt routinely does a thoracoplasty 6 weeks after resection of the lung in upper lobe for tuberculosis. Johnson advises thoracoplasty 'following pneumonectomy in non-malignant disease especially in young people with long lives ahead of them' (55). It is indeed difficult to advise a patient who has recently had a pneumonectomy for a malignant neoplasm that his operation requires at least two others. No surgeon would do so if he believed recurrence likely. But should the advantages of a thoracoplasty be denied to a man no older than 50 years of age whose neoplasm was small and apparently limited to the lung? It is a complicated question and further consideration of it is beyond the scope of his review.

From 4 to 6 hours after lobectomy gentle suction of from 10 to 15 centimeters of water should be applied continuously to the drainage tube. The remaining lobe will sooner or later fill the cavity and cover the inner opening of the tube. In order to determine when this occurs the tube should be temporarily clamped once each day disconnected from the source of suction and attached to a glass tube in a water sealed bottle. If respiratory oscillations have ceased and cannot be restored by adjustment of the tube at the thoracic wall or by the introduction of a little sterile saline solution with a syringe the tube should be removed since it is serving no useful purpose. Loculated air and further accumulations of fluid can be aspirated by thoracentesis at frequent intervals, at sites properly selected fluoroscopically until the space is obliterated. The persistence of a residual space for more than 10 days in the absence of atelectasis of the remaining lobe or of a bronchopleural fistula is unusual.

At the end of the first week after drainage of a postpneumonic empyema the space can usually be encouraged to obliterate faster if continuous suction is applied through the tube. Negative pressure as low as 150 centimeters of water (11 centimeters of mercury) has been used without demonstrable harm (54). If pressure of more than 20 centimeters of water is employed it should be increased gradually over a period of several days to avoid causing the patient pain. The capacity of the cavity should be measured with saline solutions at intervals of not more than a week, provided that no bronchial fistula is present. Serial Potter-Bucky films in various projections, after injection of iodized oil into the cavity through the tube at weekly intervals, show progressive changes in shape and decrease in size of the empyema space. When it has reached a capacity of from 30 to 50 cubic centimeters, closed drainage is con-

verted to open drainage by cutting off the tube near the skin. The remaining tube is exchanged for a smaller one which is shortened progressively over the course of weeks only as the walls of the shrinking cavity close around it and behind it. The successful treatment of a complicated or chronic empyema is often much more difficult than the simple outline given here would indicate. Various supplementary operations (alone or in combination) such as revision of drainage, extra-pleural thoracoplasty decortication and Schede thoracoplasty may become necessary.

Physiotherapy should begin on the day of operation. All major posterolateral incisions compromise to some degree the large muscles which have to do with motion of the arm and shoulder. Early motion is necessary to prevent spasm, adhesions, and atrophy of muscle and bone. Passive motion of the upper arm in a circular manner while it is elevated as high as the patient can tolerate without actual pain should be done daily during the first postoperative week. As early as the first day patients should be encouraged to help themselves by reaching and turning with the aid of the arm on the side of operation. By the third day free active motion is usually possible to the same extent as that of the good arm. It is particularly important for the patient to carry out his exercises assiduously after each stage of a thoracoplasty when neglect would allow the scapula to become tightly bound to the altered thoracic cage.

The gratifying decrease in the incidence of postoperative complications and of discomforts of convalescence which accrues from early ambulation is now too well recognized to need special emphasis here (22 25 32 57 72). These benefits are not, however, nearly as striking if early rising is postponed until the third or fourth day. At frequent intervals during the first 24 hours the patient must be made to turn from back to side and encouraged to move his legs. In addition to certain commonly accepted contraindications to early ambulation (recent coronary occlusion, danger of hemorrhage, thrombophlebitis) the presence of lowered arterial oxygen saturation, dyspnea, or severe weakness, as well as operations on the pericardium, heart, and great vessels make recumbency advisable for more than the usual length of time. With these exceptions the patient who has had an intrathoracic operation can usually sit on the side of his bed or even in a chair beside it, for two 10 minute periods during the first or second day following operation. Drainage and oxygen tubes are inconvenient but they do not prevent mobilization. Even though the patient

film is not made at the conclusion of such operations as lobectomy and pneumonectomy while the patient is still on the table, it must be obtained at the bedside on the day of operation. A conscious patient with a stable blood pressure should be supported in a sitting position so that a pleural fluid level, if fluid and air are present simultaneously will be visible on the film. Subsequent examinations, which should be carried out at intervals suitable to the case, may be done fluoroscopically and with occasional films. When gastric distention is present especially immediately after operation, a Wangenstein suction apparatus results in prompt relief. Gastric aspiration is a necessary measure for several days following vagotomy because the stomach may become enormously enlarged if it is not drained. For patients who have had an intrapleural or extrapleural pneumonolysis, fluoroscopic control is essential on the day of operation and daily for at least the first few subsequent days. An intrapleural or extrapleural pneumothorax may be lost by the escape of air into the tissues of the thoracic wall within a few hours if air is not injected when it is needed. Following pneumonectomy the mediastinum should be maintained in the midline. An acute overdistention of the remaining lung has occasionally resulted from the use of a water sealed drain (63 77). This is associated with serious lowering of the arterial oxygen saturation. Shift of the mediastinum in the other direction reduces the volume of the remaining lung and prevents adequate ventilation with the same end result, i.e. lowering of the arterial oxygen saturation. Mediastinal displacement in either direction may cause serious cardiovascular and respiratory disturbances (63 13 30).

For the first 5 to 7 days after pneumonectomy when 100,000 units of penicillin should be placed in the pleural cavity daily. If the patient is lying supine the needle may be conveniently placed in the second or third intercostal space at the mid-clavicular line. The intrapleural pressure should be measured at this time, before penicillin is introduced, by the use of a 3 way stopcock and a water manometer. The mediastinal position can then be adjusted if necessary according to the pressure readings and the fluoroscopic findings, by the withdrawal of air or fluid or the addition of air. When aspiration is required, it is preferable to remove air because the fluid is a more permanent space occupying medium. Although it is desirable for the entire hemithorax gradually to fill with fluid, the hydrostatic effect of the dependent fluid collection may be dangerous to patients with a narrow cardiocirculatory margin who can

withstand little mediastinal displacement (6). Such hydrostatic pressure can be controlled of course only by the aspiration of several hundred cubic centimeters of fluid. Adjustments of this nature should be done slowly and tentatively promptly if the patient experiences a feeling of tension within the chest, faintness, an increase in the pulse rate, or a desire to cough. Aspirated fluids should be cultured for pyogenic organisms at least on one occasion. If an extensive thoracoplasty has preceded the pneumonectomy which occasionally the case when the resection was for tuberculosis, the problem of the residual pleural space is largely solved. The postoperative Li is not needed, indeed is not wanted, in the relatively narrow pleural cavity since small accumulations of fluid may produce pressure upon the mediastinal organs. Needling of this fluid is more difficult and dangerous than other thoracentesis. For this reason an airtight, water sealed drain should be employed for several days or until the small pleural cavity is obliterated. Such a drain should be clamped near the skin for several hours postoperatively to retain penicillin in the pleural cavity. When a pneumonectomy is done without a previous thoracoplasty the empty hemithorax becomes partially filled with fluid which undergoes some organization. Resorption of pleural fluid and contraction of the connective tissue gradually cause a decrease in the size of the pleural cavity with traction and displacement of the mediastinum and consequent overdistention of the remaining lung. A year after operation one often finds that the lung has had to come to occupy far more space than it did preoperatively. On rare occasions it may apparently fill the major portion of the entire thoracic cavity. It is true that these changes occur gradually and may not be incompatible with a long life. But pulmonary overdistention or "emphysema" reduces the respiratory function (27) and puts an added burden on the right side of the heart. A further consideration is the effect of stretching upon tuberculous lesions if any should be present in the remaining lung. The patient's comfort and usefulness are thereby compromised and his ultimate life expectancy is unquestionably decreased. Since there is, at present, no satisfactory technique for introduction into the pleural cavity which will prevent this progressive undesirable change, the only alternative is the performance of early thoracoplasty. The extent to which the changes associated with chronic overdistention are reversible is not known. Once they have developed, thoracoplasty sometimes relieves dyspnea (27) but by this time the patient presents

and re-expansion was 6 weeks (64). Of 51 patients with atelectasis following the 154 lobectomies reported by Gowar 14 had a permanent collapse and 9 of these died. The longer the lobe remains atelectatic the more certain is the advent of an extensive empyema. The intrapulmonary infection which follows unrelieved atelectasis often gains access to the large pleural dead space which remains as long as the lobe is unexpanded. More over atelectasis is apparently a frequent primary stage in the development or extension of bronchiectasis. A lobe which was bronchographically normal before operation occasionally develops bronchiectasis after prolonged postoperative atelectasis (75-42).

The most effective preventives of atelectasis are the continued stimulation of the patient to cough the control of pain the use of carbon dioxide and steam and when needed intrabronchial catheter suction or bronchoscopy or both. Efforts must be redoubled when atelectasis is suspected without fear of "worrying" the patient. Since the effect of the continued perfusion of an airless lobe by its share of blood through the pulmonary artery is to reduce the oxygen saturation of blood returned to the left side of the heart oxygen administration should be continued or resumed (66). If the cough is moist and unproductive or if it does not rid the patient of moist sounds, tracheo-bronchial suction by catheter should be used freely. If this fails promptly to relieve the situation bronchoscopic aspiration should be performed repeatedly if necessary. On bronchoscopic examination there is usually no classical mucous plug. The lobar orifice may be found bubbling with mucopurulent secretions, or the obstruction may be distributed in the finer air passages deep within the lobe. The coughing produced by an intrabronchial catheter or bronchoscopic aspirator is usually very helpful in loosening viscid secretions.

Empyema. This is unlikely to follow intrathoracic operations unless (1) the pleura is heavily contaminated during operation from infected lung or other intrathoracic structures (2) intrapulmonary complications occur in the presence of a dead space or (3) bronchopleural fistula or separation of the thoracotomy wound takes place. When a bronchial fistula occurs in the presence of a large collection of intrapleural fluid as following a pneumonectomy drainage of the pleural space should be done as soon as the fistula is detected. Even if fluid under pressure were not aspirated into the lungs, a change in the patient's position could inundate the remaining lung. The opening of a bronchus is almost always followed by an

empyema. In the absence of a fistula an early empyema can sometimes be aborted by frequent aspirations and injections of large amounts of penicillin. After lobectomy the management of an empyema, once it is established, does not differ from that of any postpneumonic empyema. After pneumonectomy the empyema space can be obliterated only by an extensive thoracoplasty. When an empyema occurs after pulmonary resection in which cotton tape was used for the ligation of hilar vessels, the tape is very apt to remain as a foreign body and maintain a small but persistently draining pleurocutaneous sinus until it is removed.

Spread of infection. Postoperative spread of pulmonary infections may follow the spilling of infectious bronchial secretions into undiseased pulmonary tissue. In resection for bronchiectasis this may produce a pneumonic process although it is often difficult to distinguish such a pneumonitis from localized atelectasis. In any case it usually clears promptly with the aid of penicillin therapy. A more grave and indolent spread of infection is occasionally seen following drainage of or resection for lung abscess. Beyond the use of the antibiotics in combination with a sulfonamide there is no specific therapy for these infections. In tuberculosis, it may be impossible to distinguish a bronchogenic spread from a reactivation of latent lesions. Such fresh lesions are not uncommon after the performance of lobectomy and pneumonectomy for active tuberculosis (70-86, 84) and occasionally they occur after thoracoplasty (8) especially when the lesion collapsed by operation was fairly fresh and of a caseous pneumonic type. The presence of an active tuberculous bronchitis at the time of any operation increases the likelihood of spread. It is hoped that the use of streptomycin in selected cases before and after the operation will offer some specific protection. If a serious spread appears after any operation for pulmonary tuberculosis, this drug appears to be indicated. Further surgery should not be carried out until the new lesions disappear or have been relatively stable for at least several months.

The management of many miscellaneous complications that occasionally arise after thoracic operations, such as wound infection, wound disruption, pericarditis, and thrombophlebitis, does not differ from their management under other circumstances and therefore will not be discussed here.

SUMMARY

The occurrence of complications and death after thoracic operations is surprisingly influenced by

is weak or reluctant to rise, he is usually gratified by the rapid return of strength and appetite. Barring complications, the nontuberculous patient is able to walk freely about his room and probably to go to the toilet in less than a week.

Physiotherapy should by no means be confined to the restoration of function to the arm and shoulder after thoracoplasty or thoracotomy. The entire chest must be rehabilitated in order to prevent splinting due to pain and contracting pleural scar (46). Whether after lobectomy the remaining lobe on the side of operation ever quite regains its preoperative function is problematical. If the thoracic cage retracts and its muscular movements are impaired, lobar ventilation and gaseous exchange are certainly correspondingly reduced. A lobe so handicapped remains, in a relative sense, a space filler rather than a significant functional portion of important and irreplaceable tissue. If the disproportion between its circulation and ventilation is great enough it might even become a detriment. When a physiotherapist familiar with postoperative thoracic problems is not available for preoperative instruction and the institution of exercises immediately after operation, these duties must be carried out by the surgical staff. Exercises to promote motion of the affected hemithorax are not difficult to devise. Harken (46) suggests that the first step is to make the patient aware of his immobile chest. For this he must be placed straight in bed with the head, chest and hips aligned. The therapist's hand on the lower thoracic wall is watched by the patient. Faint respiratory motions are exaggerated by the constant firm pressure of the instructor's hand. At the end of expiration an added thrust is given with the hand after which this support is quickly released and the patient should attempt to exaggerate the recoil. He gradually becomes conscious of the area and of its more or less faint respiratory motion and should continue his attempts, with assistance and in a methodical manner to increase its motion. During the recent war both British and American thoracic centers carried a program of rehabilitation to a degree which should be the envy of civilian surgeons (35, 44, 46, 49). To graded bending, twisting and stretching exercises were later added swimming and cross-country running. The patients' progress was graphically demonstrated to them by progressive increase in the measurement of their chest expansion and vital capacity and in their increasing strength and endurance (35). Similar results would be difficult to duplicate outside a disciplined organization where patients can be supervised for weeks. Neverthe-

less, it is a part of the surgeon's responsibility to use every care to avoid leaving his patient with surgically imposed remediable handicap.

COMPLICATIONS

It is difficult to separate the combination of interrelated factors which determine a smooth or stormy postoperative course. Attention to any of the details discussed will often avert ones that may take place after operation. There are, however, certain important complications which occur with sufficient regularity as to merit separate consideration as clinical entities.

Atelectasis. After lobectomy for suppurative disease, atelectasis of the remaining lobe on the side of operation is one of the most frequent of troublesome possibilities. The reported incidence varies from 10 per cent (64) to 33 per cent (7). It occurs almost 2½ times more often on the left side than on the right (41) and is far commoner in the upper lobe after lower lobe lobectomy than in the lower lobe after upper lobe lobectomy (64). Sampson and Collis have found that it occurs in women and men in a ratio of 5 to 2. Gray (43) has stated that it is twice as frequent in children as in adults. The incidence seems to increase after the resection of more than one lobe (75). The chief etiologic factor is the retention of secretions in the lobar bronchial tree. Important factors which contribute to retention of secretions are inadequate coughing due, in part, to pain; a paralyzed diaphragm and mobile mediastinum; a bronchopleural fistula; or the presence of a large drainage tube. Often turning the patient on his good side and having him cough vigorously produces a striking return of previously absent breath sounds. The full blown syndrome is frequently averted in this way. While atelectasis may occur during the immediate postoperative period, the remaining lobe usually appears in the roentgenograms to be satisfactorily aerated during the first 24 to 48 hours. Then, between the second and fifth days (44), when a splinted thoracic wall compromises lobar ventilation and drainage, the breath sounds over the upper chest anteriorly are found to be suppressed and the roentgenogram reveals a sharply opaque lobe. Unless secondary suppuration occurs the symptoms are relatively mild. The temperature and pulse may be somewhat elevated, cyanosis is occasionally apparent but, as a rule, the patient notices little subjective change except possibly mild dyspnea. Atelectasis usually clears within a week if it is promptly and energetically treated. It may, however, persist for many weeks. None of Miler's 8 cases remained permanently atelectatic; the longest interval between collapse

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the extent to which many details of preoperative and postoperative management are carried out. Of particular importance is the rapid restoration of the normal anatomical position of the heart and lungs and the maintenance of an efficient coughing mechanism.

The use of antibiotics, fluid and blood replacement, oxygen administration evacuation of bronchial secretions pleural drainage regulation of mediastinal position early mobilization rehabilitation and the prevention and treatment of a few of the common complications have been briefly discussed

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which appeared as spotty as the elastic degeneration shown by the orcein stain. In some places the edges of the breaks extended into the deeper layers of the choroid. Separation of the pigment epithelium occurred as a result of a cuticular substance produced by the epithelium and extravasation from the choriocapillaris or by a mixture of glial and fibrous tissue with capillaries derived from the pigment epithelium and the choroid respectively.

Correlation of the clinical and histological findings as discussed in some detail. It is believed that the pathogenesis of angioid streaks is based upon an abnormal fragility and opacification of the lamina basalis of the choroid. Variations in intraocular pressure or slight pressure in the eyeball in such cases may cause the breaks which are visible because of the loss of translucency of the membrane. The frequent association with pseudoxanthoma elasticum (not present in this case) suggests a primary inferiority of the elastic tissue in the body. Deposition of calcium into the membrane seems to be essential to all except the earliest manifestations of the disease.

WILLIAM A. BLANK M.D.

The Effect of Aluminum and Its Alloys on the Eye:
A Report Presented to the Vision Committee
of the Medical Research Council L. H. SAVIN
Brit J Ophth 1947 31 449

The author reports a case in which a piece of aluminum metal was observed over a period of 3 years as it lay on the retina of an only eye in a young British sergeant. At first the metallic object was bright and silvery but later it presented a white coating which was believed to be aluminum hydroxide. After shifting twice and leaving a retinal imprint each time it eventually disintegrated into a white powder.

Another case acted in a similar manner.

The experimental introduction of fragments of aluminum and aluminum alloys ranging in size from 0.3 to 20 mgm. into the anterior and vitreous chambers of rabbits revealed that there was no clinical difference between the behavior of pure aluminum and that of various alloys, but the ocular reaction tended to be more severe in the case of the higher doses. In other words there is much less toleration for larger fragments than for smaller ones.

All of the fragments became coated with white powder, yellowish exudate, fibrin and in late cases with jelly. Powdering and fragmentation occurred late, and in 6 cases the fragment was completely absorbed.

The effects on the eye included the development of the following lens opacities in 28 eyes: striae, dots, vacuoles, and irregular opacities. Of the opacities 5 were anterior capsular, 6 anterior cortical, 4 posterior cortical, 2 capsular imprints, and 3 complete cataracts. Quiet uveitis occurred in many cases. There were 10 cases of posterior synechias, 2 cases of iris bombe and 14 cases of atrophy of the iris. The fundus presented pigmentation in 23 cases, localized choroiditis in 6 and retinitis proliferans in 3 cases.

Histologic investigations revealed hyalinization and vascularization of the cornea, iritis, and atrophy and abnormal pigmentation of the iris. Pathologic changes in the retina and choroid were present in many instances.

As a result of the clinical and experimental investigation it is concluded that the eye is by no means inert to aluminum.

Aluminum and its alloys produce widespread changes in the eye regardless of the size or position of the fragment. Although aluminum and its alloys are not so destructive to the ocular tissues as iron and steel, whenever possible they should be removed surgically. This applies especially to foreign bodies in the anterior chamber. However in many cases technical difficulties preclude removal for example intravitreal fragments may have to be left alone unless their size is such that loss of the eye would be inevitable.

JOSHUA ZUCKERMAN M.D.

Ocular Infections. JOHN G. BELLON and CHESTER J. FARMER, *J Am Ass* 1947 135 491

The authors report that streptomycin is useful for various infections caused by organisms either insensitive or resistant to sulfonamide compounds and penicillin. Streptomycin is bacteriostatic against certain gram positive organisms as well as against a variety of hitherto resistant gram negative forms.

For acute conjunctivitis drops of streptomycin (10,000 micrograms per cubic centimeter) are instilled at 1 hour intervals during the waking hours (8 or 9 times a day) and continued for a period of 8 days.

Penetrability of the cornea to streptomycin may be increased by abrasion, inflammation, ion transfer, and by wetting agents.

Streptomycin is safe and nonirritating to the surface of the eyeball in concentrations up to 10,000 micrograms per cubic centimeter. Higher concentrations delay regeneration of the epithelium and may promote scarring and vascularization of the cornea.

Intracocular injections of 500 micrograms of streptomycin in 0.1 c.c. of isotonic sodium chloride solution may be administered. If the drug is injected within from 6 to 8 hours after inoculation as few as 25 micrograms of streptomycin have been found effective in the prevention of experimental beta hemolytic streptococcal infections of the vitreous.

Experimentally corneal infections caused by the *Bacillus pyocyaneus* are completely controlled by 3 instillations of streptomycin drops (10,000 micrograms per cubic centimeter) if made at 2 hour intervals within from 6 to 8 hours after inoculation.

Streptomycin was employed in 23 clinical cases of ocular infection. It was exceptionally effective in a case of primary meningococcal conjunctivitis and in a case of *Bacillus pyocyaneus* infection of the cornea.

In most cases of acute or chronic infections of the conjunctiva and cornea organisms are rapidly eliminated by streptomycin therapy and in the absence of complicating factors rapid healing ensues.

JOSHUA ZUCKERMAN M.D.

ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

The Lamina Cribrosa and Its Nature. MARIAN WILCZEK *Brit J Ophth.* 1947 3 557

The author discusses our knowledge of the nature of the lamina cribrosa. This structure which has been likened to a membrane of India rubber is generally accepted to be a semi-independent scleral structure of which the dimensions are known. Its planes, thickness and backward curve have all been measured.

To understand the structure of the cribriform lamina it is necessary to know its relation to the sclera and septa of the optic nerve. The cribriform lamina develops comparatively late, as late as the end of fetal life or even the beginning of extrauterine life. Trabeculae of connective tissue grow into the nerve and disk from all directions from the pia mater from the sclera in the scleral canal, and from connective tissue which accompanies the central vessels.

Wilczek introduces the concept of the "nest" of the optic disk. Bundles of nerve fibres are separated by neuroglial tissue. Connective cells grow into these neuroglial septa to supply the nerve with vessels. Connective tissue divides the nerve into smaller and smaller bundles and forms first, second and third grade septa but still smaller septa are formed by neuroglia. There is no sharp division between the pia or dura mater and the sclera as meningeal sheaths pass into and coalesce with the sclera.

One of the most important functions of the cribriform lamina is considered to be fixation of the optic nerve in the scleral canal, where the optic nerve is exposed to the danger of being pulled. The cribriform lamina should not be considered as an independent structure but as the foremost and strongest part of the septal system of connective tissue of the nerve.

JOSHUA ZUCKERMAN, M.D.

EYE

Ocular Injuries in Soldiers. BENJAMIN RONES and HELENER CA F ELL WILDER. *Am. J Ophth.* 1947 30 1143.

Of approximately 4,000 eyes enucleated in army hospitals between Pearl Harbor and V J Day 204 were removed because of nonpenetrating ocular injuries, 47 occurring during combat or training and 57 occurring before the patient entered the service.

The interval between injury incurred during combat or training and enucleation varied from less than 1 day to 3 1/4 years. The eyes enucleated on the day of injury had fresh hemorrhage as the dominant finding. As the time interval between the date of injury and enucleation lengthened organization of

the hemorrhage became more apparent, the signs of chronic inflammation and secondary glaucoma increased and atrophic changes took place. Iru, pupillary and cystic membranes, calcium deposits in the lens, and phthisis bulbi were observed. Cruciate cataracts, dislocated lenses, detachment of the retina and choroid, and evulsion of the eye nerve were present in many eyes.

In the cases of the 57 eyes that had been operated before induction the interval between injury and enucleation was from 4 to 38 years. Chronic endophthalmitis was the most frequent finding in this group with cataract detachment of the retina and choroid and secondary glaucoma following in the order. A great variety of degenerative and inflammatory changes were recorded. The eyes had an endophthalmitis due to tissue trauma and subsequent hemorrhage but in which the condition was not complicated by surgery or secondary infection. There was a paucity of cellular response in contrast to the cellularity of infectious uveitis with lymphocytes and plasma cells as the dominant cell types. Exudative response was marked and resulted in the formation of synechiae and pupillary and cyclitic membranes.

ROBERT H. JOHNSON, M.D.

Angioid Streaks. BENJAMIN A. KLEIN. *Am. J Ophth.* 1947 30: 955

Five clinical cases of angioid streaks are recorded with an additional clinical case in which there was a later histopathological study following enucleation of both eyes after death of the patient from aneurysms with severe cerebral hemorrhages.

Previous histological findings recorded by Beck and Hagedoorn were confirmed, and some new observations made. As previously noted, the degeneration of the elastic portion of Bruch's membrane leading to ruptures and dehiscences was sufficient to render the membrane opaque. Also observed as in the 2 previously reported histological studies, was a coexisting vascular disease affecting chiefly the posterior ciliary and choroidal vessels. The positive iron stain of the lamina basalis in the posterior polar region previously mentioned, was also found in these eyes.

A study of the morphological characteristics of the eyes in the present report showed that the earliest ruptures were limited to the elastic portion of the membrane with the cuticular layer the pigment epithelium and the overlying retina remaining intact. There were two types of defects: (1) abrupt vertical severance and (2) oblique dehiscence, influenced in character perhaps by the previous calcification or degeneration of the elastic tissue. A positive Kossa stain demonstrated the calcification

In the author's 7 cases there was more or less clearing of the corneal opacities without further ulceration of the cornea. The shrunken fornices were deepened. ROGER H. JOHNSON M.D.

Vertical Motor Anomalies. Discussion of Miss Kramer's Paper. MARY EVERIST KRAMER and E. A. W. SHEPPARD. *Am. J. Ophth.*, 1947 30 1113

This article is based on the study and treatment of 67 cases of vertical squint most of which were complicated by lateral deviation. The author listed 5 types of recognized vertical deviations (1) concomitant, (2) vertical, due to unclear and infranuclear paresis, (3) vertical, due to supranuclear paresis, (4) pseudoparetic hyperphoria, and (5) vertical of dissociated type. The value of making an accurate diagnosis was stressed.

In concomitant hypertropia the amount of vertical deviation is approximately equal in the whole field of fixation and, often fusion training will relieve the patient of his symptoms but will not correct the hypertropia. At this time attention should be given to the lateral fusional range. The treatment of a paretic hypertropia is not orthoptic but medical and surgical. Fusional training however is often highly beneficial in recovered cases of paresis in that it makes for better co-ordination of the 2 eyes in binocular vision. The vertical deviations due to a supernuclear paresis are not within the realm of orthoptics and therefore are not discussed. Pseudoparetic hyperphoria is characterized by overaction of the inferior oblique muscle without a deficiency of the superior oblique muscle of the same eye or the superior rectus muscle of the opposite eye. Hyperphoria is not present in the primary position. No orthoptic treatment is indicated unless the patient is having symptoms although most vertical phorias have a coexisting lateral component which when corrected frequently causes the disappearance of the pseudoparetic hyperphoria. Dissociated vertical divergence is characterized by a variable hyperphoria of the eye which is not fixing and is the most amenable of all vertical motor anomalies to orthoptic treatment. Surgery is contraindicated.

Orthoptically the treatment of these vertical phorias is essentially the establishment of good fusion and the correction of the amblyopia which is frequently present. Dissociation training aids in teaching voluntary control of the vertical deviation. A cure has been effected only after the dissociation exercises both for near and distance can be accomplished with comparative ease and good binocular stability is established. ROGER H. JOHNSON M.D.

Mycotic Obstruction of the Nasolacrimal Duct (Candida Albicans). MAX FINE and WILLIAM S. WARING. *Arch. Ophth.*, 1947 38 39

The authors present their observations in 2 cases of obstruction of the nasolacrimal duct by fungi. Fungi especially streptothrix and leptothrix often produce obstruction of the lacrimal passages. In most cases the obstruction consists of mycotic con-

cretions in the lacrimal canaliculi in only a few cases is the obstruction situated in the nasolacrimal duct.

An intensive study of the mycotic flora of normal and of diseased eyes by Fuzakas revealed that, in descending order of frequency the following fungi were recovered most often: *Penicillium Torula*, *Alternaria Schizosaccharomyces hominis*, *Haplosporidium* and *Aspergillus*. *Actinomyces* is most often encountered in concretions of the canaliculi.

Two cases of mycotic obstruction of the nasolacrimal duct are reported. The yeast was identified as *corpus albicans* in 1 case and the organism was not identified in the other case.

Immediate and spontaneous recovery followed extraction of a castlike obstruction of the duct.

JOSHUA ZUCKERMAN M.D.

Local Penicillin Therapy of Hypopyon Formation with Special Reference to the Use of Subconjunctival Injection. ARNOLD SOREY and HOWARD REED. *Brit. J. Ophth.*, 1947 31 518.

The authors discuss not only the ocular indications for the use of penicillin locally but also the optimal methods for its employment locally.

In order to be effective, drops have to be instilled at frequent intervals. Lamellae have not proved satisfactory. Ointments present difficulties concerning the best base to employ. Solid penicillin is effective when applied directly to an infected ulcer (Juler and Young, 1945).

Subconjunctival injection of penicillin was found superior to all other modes of applying penicillin. The following method of treatment is employed:

1. A smear is taken for culture purposes.
2. The conjunctiva is anesthetized by instillation of several drops of a local anesthetic.
3. A half cubic centimeter of a 2 per cent novocain solution and 0.5 c.c. of epinephrine hydrochloride (1:1000) is injected into an ampoule containing 100,000 units of white crystalline penicillin. A half cubic centimeter is then withdrawn and injected subconjunctivally.
4. Atropine is instilled and the eye may be bandaged.
5. Injections are repeated at 6 hour intervals for 3 days, a total of 12 injections being given in all cases. If indicated another 4 injections may be given over an additional day.
6. After the injections are discontinued penicillin ointment in a concentration of 100,000 units per gram is introduced every 4 hours day and night. The ointment is made with a specially prepared base of 90 parts of petroleum jelly and 10 parts of liquid paraffin. Use of the ointment is continued for 48 hours after apparent clinical cure.

In other words from 12 to 16 subconjunctival injections are administered at intervals of 6 hours. Each injection contains 50,000 units of penicillin (dissolved in 0.25 c.c. of 2 per cent novocain and 0.25 c.c. of 1:1000 adrenalin). This treatment is followed by the introduction of penicillin ointment every 4 hours in a concentration of 100,000 units per gram.

The Distribution of Penicillin in the Eye after Subconjunctival Injection. ARNOLD SOREBY and J. UNGER. *Brit. J. Ophth.* 1947 31 517

The authors discuss the distribution of penicillin in the eye following subconjunctival injection of the drug. Adequate intraocular concentrations of penicillin can be achieved by systemic administration of massive doses, by the application of highly concentrated ointments, and by subconjunctival injections. The highest and most persistent intraocular concentration can be obtained by subconjunctival injection especially when the penicillin is combined with epinephrine hydrochloride solution (1:1000) as a solvent.

Subconjunctival injection of 50,000 units of penicillin produces high intraocular levels. The introduction of ointment in concentration of up to 40,000 units per gram does not maintain any adequate intraocular levels after 2½ hours, neither does systemic administration of the drug. The overwhelming advantages of subconjunctival injections are beyond question.

It is pointed out that an injection of 50,000 units is preferable to one of 10,000 units because the former not only gives a considerably and disproportionately higher level of intraocular concentration but this level is maintained for a longer period of time. Injections should be given at intervals of 6 hours to maintain adequate levels.

Normal saline solution as a solvent is unsatisfactory because penicillin dissolved in it becomes a hypertonic solution. Adrenalin as a solvent has many advantages. Two per cent novocain hydrochloride solution may also be used as a solvent in painful eyes.

JOSHUA ZUCKERMAN, M.D.

Streptomycin in Ophthalmology J. G. BELLONS and C. J. FARMER. *Am. J. Ophth.* 1947 3 115

The authors describe the use of streptomycin in ophthalmology. Although thousands of strains and species of actinomyces, fungi, and bacteria have been investigated for antibiotic action and therapeutic usefulness, only penicillin and streptomycin have proved to be of therapeutic importance. Penicillin is more valuable, but streptomycin has been found to be superior to penicillin in the control of certain specific organisms.

Streptomycin is safe and nonirritating to the surface of the eyeball in concentrations up to 10,000 mcgm. per milliliter. Higher concentrations delay regeneration of the epithelium and promote scarring and vascularization of the cornea.

Intravitreal injections of 500 mcgm of streptomycin in 0.1 ml. of saline solution are well tolerated. Effective therapeutic concentration is maintained in the vitreous for more than 24 hours by intraocular injection of 100 mcgm of streptomycin.

Because local application of streptomycin decreases the amount of secondary infection accompanying vaccinia infections of the cornea, treated eyes become less scarred and less vascularized.

JOSHUA ZUCKERMAN, M.D.

A Statistical Study of Glaucoma. J. C. HARRIS. *J. Ophth.* 1947 30 187

The author made a statistical study of glaucoma. He reports that at the University Eye Clinic in 1930 between 1930 and 1939 among 2,177 adults (55 per cent men, and 45 per cent women) there were 2167 cases of glaucoma divided as follows: 120 cases of glaucoma simplex of which 63 per cent were in men and 38 per cent in women, and 193 cases of congestive glaucoma, 55 per cent of which were men and 64 per cent in women. Glaucoma simplex constituted 53.4 per cent of all of the cases, all congestive glaucoma constituted only 6.6 per cent.

Hypermetropia occurred in fully 55 per cent of the cases, emmetropia in 50 per cent, and myopia in 2 per cent. Almost 5 per cent of the cases were astigmatic. In this series of cases the preponderance of emmetropia was very marked.

Three hundred and seventy five cases (8.5 per cent of 439 examined for the possible presence of cataract of the lens capsule presented this condition. In the 53 cases of unilateral glaucoma in which cataract was found on only one side. It was always in the glaucomatous eye.

JOSHUA ZUCKERMAN, M.D.

An Operation for Trachomatous Pannus. H. L. RABDO. *Am. J. Ophth.* 1947 30 109

The author described a surgical method in the treatment of severe and persistent cases of trachoma with pannus formation. Since he believes that the presence of capillaries in the superficial layers of the cornea is essential to the formation of the trachomatous pannus, and since these capillaries are not spring from the blood vessels of the conjunctiva, he reasoned that the best treatment for this condition would be to remove the conjunctiva from the limbal region permanently. The operative procedure was as follows:

The conjunctiva was incised as close to the limbus as possible and then dissected all around to the limits of the fornices. The subconjunctival tissue was then carefully removed for about 6 millimeters around the limbus to leave a very thin sclera. The remnants of the conjunctiva at the limbus were curetted away and the active blood vessels in the cornea were split with the point of a catgut knife. One needle of a double armed silk suture was inserted in the scleral side of the conjunctiva in the superior temporal quadrant about 10 millimeters from its margin, passing parallel to the margin for about 6 millimeters and then coming back through the conjunctiva. Both ends of the suture were then carried up between the sclera and the conjunctiva to emerge through the skin under the brow where they were tied over a small roll of gauze. The procedure was followed in all 4 quadrants. The conjunctiva was held at an equal distance from the limbus all around the cornea.

The advantage of this operation was that there was a permanent disappearance of the blood vessels from the cornea with a consequent recovery from the pannus.

der to relieve the most nauseating and distressing symptoms—diplopia. Diplopia may be associated with mental confusion and headache. Following resection of the vertical deviation by surgical procedures, binocular reflexes assisted by orthoptic training maintain fusion within the range of normal ocular movement. Orthoptic exercises prevent suppression of the affected eye and maintain the tone of the extraocular muscles. If the deviation is marked it may be corrected in stages to avoid possible overcorrection with resultant relative paresis. After operation exercises will strengthen the binocular reflexes and increase the fusion hold of the newly restored binocular vision. Residual defects can then be corrected.

Neely points out that traumatic diplopia is not an uncommon sequel to head injuries; that the diplopia usually results from paresis, not from paralysis of an extraocular muscle; that the diplopia is caused by a "closed" head injury rather than by a penetrating head wound; that the vertically acting muscles are most often affected; that injuries to the orbit may be overlooked or masked by swelling of the surrounding tissues; and that roentgen ray diagnosis of fractures of the floor of the orbit is difficult unless stereoscopic plates are taken.

Fractures which involve the orbit require restoration of the normal anatomy of the parts and building up of the orbital floor by means of a bone inlay. To overcome the residual diplopia and restore binocular single vision, eye muscle surgery aided by orthoptic exercises is required.

JOSUA ZUCKERMAN, M.D.

NOSE AND SINUSES

Role of Penicillin in the Management of Acute and Chronic Frontal Sinusitis. KENNETH M. KAHN, *Arch. Otolaryng., Chic.* 1947 46 293

Seven patients with sinus disease were treated with penicillin plus indicated surgical measures. In the 6 cases in which supuration was present, surgical measures were necessary for cure. Penicillin given in these cases prevented dissemination of infection by its bacteriostatic action. Twenty five thousand units were given intramuscularly every 3 or 4 hours. One patient with a complicating meningitis was given 50,000 units intramuscularly every 3 hours and 15,000 units intrathecally daily. In 3 cases penicillin filled into the wound through fixed urethral catheter was considered to aid in early primary wound cure.

JOHN R. LINDSAY, M.D.

Regenic Tumors of the Nose and Throat. GORDON B. NEW and KENNETH D. DEVIDE, *Arch. Otolaryng., Chic.* 1947 46 163

In the last 27 years at the Mayo Clinic, 33 cases of regenic tumors in the nose or throat have been treated. These include 9 cases of developmental and 24 cases of neoplasm.

There were 6 cases of meningocele. Four of the lesions were large pulsating compressible tumors at the root of the nose. In an

other case there was a small, firm rounded mass at the root of the nose, which was thought to be a dermoid cyst. At the time of operation it was recognized as a meningocele and the pedicle was ligated. In 1 case the tumor presented as a cyst of the nasal cavity. Meningoceles are neurosurgical problems.

There were 3 cases of encephalocele. The tumors were firm, rubbery, round congenital tumors at the root of the nose lying just to the right of the midline. Small external encephaloceles with no intranasal or intracranial connections are best removed through a horizontal incision over the root of the nose. These tumors are not encapsulated and must be removed by sharp dissection, care being taken to remove all of the tumor.

An intranasal encephalocele may have intracranial connections. For this reason any surgical procedure for its removal must furnish adequate exposure so that the distal pedicle or attachment of the tumor may be ligated or electrocoagulated if there is any evidence of intracranial connection.

There were 19 neurofibromas. Among these 19 cases there were only 4 of Recklinghausen's disease. Neurofibromas of the oropharynx, hypopharynx and tonsillar region are best attacked surgically through the mouth after preliminary ligation of the external carotid artery on the side involved. They shelled out easily from the capsule and rarely recur. An occasional pharyngeal neurofibroma may be so large that it is necessary to do preliminary tracheotomy. It is usually necessary to approach these large tumors through an external incision. If the location of the tumor prevents shelling it out, destruction of the tumor by surgical diathermy may be necessary.

There was only 1 ganglioneuroma. This was a firm tumor involving the left basal region of the tongue extending forward to a point opposite the bicuspid area, back almost to the tip of the epiglottis, and down through the floor of the mouth where it presented in the left submaxillary region. After preliminary ligation of the left external carotid artery the tumor was removed through the mouth.

There were 4 cases of meningioma. In 3 cases the tumor was in the frontal sinus and in 1 case it was located subcutaneously at the root of the nose. Meningiomas in the nasal sinuses and located subcutaneously at the root of the nose are best removed by surgical diathermy.

MOUTH

Prosthetic Restoration of Palate. A. H. KAZANTZAK, *J. Oral Surg.* 1947 5 181

The author discusses the value of various types of prosthetic appliances which may be utilized along with or following surgical procedures for the correction of deformity of the upper jaw.

Deformities of the maxilla may be congenital or acquired. Cleft palate is the most common congenital deformity. Prostheses are of value when surgery results in failure or only partial success. After suc-

It is pointed out that if no substantial response is obtained at the end of 48 hours further injection of penicillin is useless.

A series of 66 patients with hypopyon was treated with penicillin. There were 39 cases of infected corneal ulcer 18 of which were treated by subconjunctival injections of penicillin in doses of 30,000 units with or without the application of penicillin ointment. Infected corneal ulcers responded well to treatment. Eighteen of 21 cases of infected corneal ulcer with hypopyon responded to subconjunctival injections. Hypopyon associated with herpetic or neuropathic keratitis gave no response. Hypopyonitis required no treatment other than atropine.

General sulfonamide therapy was used in 3 patients when subconjunctival injections of penicillin were inadequate
 JOSHUA ZUCKERMAN, M.D.

Bilateral Uveitis from Horse Serum. T. F. SCHLAEGEL, JR. *Am. J. Ophth.* 1947 30 1 5

The author describes the development of bilateral granulomatous uveitis in rabbits after the use of normal horse serum.

In every case in which the right eyes of rabbits were injected with serum and later given repeated large doses intravenously the reaction was severe in the injected eyes and moderate in the un.injected.

The uvea revealed infiltration by lymphocytes, large mononuclear phagocytes, plasma cells, and epithelioid cells. Injected eyes developed replacement fibrosis and involvement of the retinas, whereas the infiltration in the un.injected eyes remained fresh and the retinas were not affected.

A second series of experiments was performed to elucidate the mechanism of this contralateral response. The rabbits received the original injection intracutaneously instead of into the right eye.

Not only the clinical but also the microscopic reactions in the un.injected eyes of the first series were significantly greater than the reactions in the un.injected eyes of the second series. The cause of this apparent superiority of the eye over the skin for predisposition to a reaction in un.injected eyes was not determined.
 JOSHUA ZUCKERMAN, M.D.

Penicillin Therapy of Experimental Infections of the Lens and Vitreous with *Clostridium Welchii*. LEON C. HOSKINS. *Arch. Ophth.*, Chic. 1947 38 30

The author discusses penicillin therapy of infection of the eye by *Clostridium welchii*. Infections of this type which are relatively common among battle casualties are now effectively controlled by penicillin. Because penicillin iontophoresis failed to check infection of the lens by this organism, experimental infection of the lens and vitreous was undertaken.

Hoskins found that direct injection of penicillin into the lens and vitreous satisfactorily controlled infections with the *Clostridium welchii* if the therapy was instituted within 3 hours after the inoculation.

The results were less favorable when the interval between the infection and the treatment was increased to 6 hours.

In a series of 3 hour cases a beneficial effect was obtained with only moderate damage to the structures of the eye.
 JOSHUA ZUCKERMAN, M.D.

Dicumarol and Rutin in Retinal Vascular Disorders. ARTHUR L. MACLEAN and GORDON I. BRANNEN. *Am. J. Ophth.* 1947 30 1093

The purpose of the authors was to present to concomitant use of dicumarol and rutin in retinal retinopathies. The mechanism of retinal vessel occlusion was presented as a slowing of the blood flow followed by the formation of a thrombus on the endothelium upon which cells and fibrin are deposited so that an organized thrombus protrudes into the lumen of the vein. When dicumarol is administered orally the prothrombin activity of the blood is reduced and intravascular thrombus as well as intravascular coagulation is inhibited in this manner the enlargement of the clot by continued fibrin deposition may be prevented. The prothrombin, if its growth is checked, may leave less for the passage of blood. Rutin was used to decrease capillary fragility when present.

In this series of 21 cases dicumarol was given in dosages to maintain a coagulative activity level of 30 per cent of the normal. In more than one-half of the cases rutin was usually given orally at the same time in 60 milligram doses daily. The dicumarol produced a minimum of untoward side reactions and no toxic manifestations were observed from its rutin.

The present series of cases of various retinopathic conditions manifested a definite decrease in the prothrombin clotting time compared to normal controls. Dicumarol and rutin therapy in a case of tributary occlusion showed an increased rate of improvement, but in 6 cases of central vein occlusion the rate of recovery was variable. Four patients with diabetic retinopathy presented improvement in their visual acuity and absorption of hemorrhages when treated with dicumarol and rutin. The retinopathic condition manifested by macular and perimacular edema with attenuated vessels was decreased in a short time with rutin and dicumarol. Two patients with Eales disease were found to have a strongly positive Goethlin index and rutin alone produced improvement.

The primary etiologic factor of degenerative retinopathy probably rests upon vascular sclerosis and the secondary process of thrombosis. Dicumarol therapy produced an improvement in all cases of this type.
 ROBERT H. JONKOWSKI, M.D.

The Treatment of Traumatic Diplopia. J. C. XIMENEZ. *Brit. J. Ophth.* 1947 3 531.

The author reports his findings concerning the incidence and causes of accommodative asthenopia and discusses the treatment of traumatic diplopia.

Before the war there was no recognized technique for correction of traumatic diplopia.

As far as the vertically acting muscles are concerned it is not necessary to obtain orthophoria.

ler to relieve the most nauseating and distressing symptoms—diplopia. Diplopia may be associated with mental confusion and headache. Following resection of the vertical deviation by surgical procedures, binocular reflexes assisted by orthoptic training maintain fusion within the range of normal ocular movement. Orthoptic exercises prevent suppression of the affected eye and maintain the tone of the extraocular muscles. If the deviation is marked it may be corrected in stages to avoid possible overcorrection with resultant relative paresis. After operation exercises will strengthen the binocular reflexes and increase the fusion hold of the newly restored binocular vision. Residual defects can then be corrected.

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The present series of cases of various retinopathies manifested a definite decrease in the prothrombin clotting time compared to normal controls. Dicumarol and rutin therapy in 2 cases a tributary occlusion showed an increased rate of improvement, but in 6 cases of central vein occlusion the rate of recovery was variable. Four patients with diabetic retinopathy presented improvement in their visual acuity and absorption of hemorrhage when treated with dicumarol and rutin. The retinopathic condition manifested by macular and perimacular edema with attenuated vessels was cleared in a short time with rutin and dicumarol. Ten patients with Eales disease were found to have a strongly positive Goethlin index and rutin alone produced improvement.

The primary etiologic factor of degenerative retinopathy probably rests upon vascular sclerosis and the secondary process of thrombosis. Dicumarol therapy produced an improvement in all cases of this type. ROGER H. JOHNSON, M.D.

The Treatment of Traumatic Diplopia. J. C. KERR. *Brit J Ophth* 9:47 3 38

The author reports his findings concerning the incidence and causes of accommodative asthenopia and discusses the treatment of traumatic diplopia.

Before the war there was no recognized technique for correction of traumatic diplopia.

As far as the vertically acting muscles are concerned it is not necessary to obtain orthophoria in

her to relieve the most nauseating and distressing symptoms—diplopia. Diplopia may be associated with mental confusion and headache. Following resection of the vertical deviation by surgical procedure, binocular reflexes assisted by orthoptic training maintain fusion within the range of normal ocular movement. Orthoptic exercises prevent suppression of the affected eye and maintain the tone of the extraocular muscles. If the deviation is marked it may be corrected in stages to avoid possible overcorrection with resultant relative paresis. After operation exercises will strengthen the binocular reflexes and in case the fusion hold of the newly restored binocular vision. Residual defects can then be corrected.

Neely points out that traumatic diplopia is not an uncommon sequel to head injuries; that the diplopia usually results from paresis, not from paralysis of an extraocular muscle; that the diplopia is caused by a closed head injury rather than by a penetrating wound; that the vertically acting muscles are most often affected; that injuries to the orbit may be overlooked or masked by swelling of the surrounding tissues; and that roentgen ray diagnosis of fractures of the floor of the orbit is difficult unless stereoscopic plates are taken.

Fractures which involve the orbit require restoration of the normal anatomy of the parts and building up of the orbital floor by means of a bone inlay to overcome the residual diplopia and restore binocular single vision; eye muscle surgery aided by orthoptic exercises is required.

JOSHUA ZUCKERMAN, M.D.

NOSE AND SINUSES

Role of Penicillin in the Management of Acute and Chronic Frontal Sinusitis. KERKOTZ M. KAHN. *Arch. Otolaryng. Chlc.* 1947 46 293.

Seven patients with sinus disease were treated with penicillin plus indicated surgical measures. In the 6 cases in which suppuration was present surgical measures were necessary for cure. Penicillin given in these cases prevented dissemination of infection by its bacteriostatic action. Twenty five thousand units were given intramuscularly every 3 or 4 hours. One patient with a complicating meningitis was given 50,000 units intramuscularly every 3 hours and 15,000 units intrathecally daily. In 3 cases penicillin instilled into the wound through fixed urethral catheters was considered to aid in early primary wound closure.

JOHN R. LINDRAY, M.D.

Neurogenic Tumors of the Nose and Throat. GOA DOW, B. NEW and KERKOTZ D. DEVINE. *Arch. Otolaryng. Chlc.* 1947 46 163.

In the last 27 years at the Mayo Clinic, 33 cases of neurogenic tumors in the nose or throat have been encountered. These include 9 cases of developmental error and 24 cases of neoplasm.

There were 6 cases of meningocele. Four of the meningoceles were large pulsating compressible, congenital tumors at the root of the nose. In an

other case there was a small, firm rounded mass at the root of the nose which was thought to be a dermoid cyst. At the time of operation it was recognized as a meningocele and the pedicle was ligated. In 1 case the tumor presented as a cyst of the nasal cavity. Meningoceles are neurosurgical problems.

There were 3 cases of encephalocele. The tumors were firm rubbery round congenital tumors at the root of the nose lying just to the right of the midline. Small external encephaloceles with no intranasal or intracranial connections are best removed through a horizontal incision over the root of the nose. These tumors are not encapsulated and must be removed by sharp dissection, care being taken to remove all of the tumor.

An intranasal encephalocele may have intracranial connections. For this reason any surgical procedure for its removal must furnish adequate exposure so that the distal pedicle or attachment of the tumor may be ligated or electrocoagulated if there is any evidence of intracranial connection.

There were 19 neurofibromas. Among these 19 cases there were only 4 of Recklinghausen's disease. Neurofibromas of the oropharynx, hypopharynx, and tonsillar region are best attacked surgically through the mouth after preliminary ligation of the external carotid artery on the side involved. They shell out easily from the capsule and rarely recur. An occasional pharyngeal neurofibroma may be so large that it is necessary to do preliminary tracheotomy. It is usually necessary to approach these large tumors through an external incision. If the location of the tumor prevents shelling it out, destruction of the tumor by surgical diathermy may be necessary.

There was only 1 ganglioneuroma. This was a firm tumor involving the left basal region of the tongue, extending forward to a point opposite the bicuspid area, back almost to the tip of the epiglottis and down through the floor of the mouth where it presented in the left submaxillary region. After preliminary ligation of the left external carotid artery the tumor was removed through the mouth.

There were 4 cases of meningioma. In 3 cases the tumor was in the frontal sinus and in 1 case it was located subcutaneously at the root of the nose. Meningiomas in the nasal sinuses and located subcutaneously at the root of the nose are best removed by surgical diathermy.

MOUTH

Prosthetic Restoration of Palate. V. H. KASARIAN. *J. Oral Surg.* 1947 5 181.

The author discusses the value of various types of prosthetic appliances which may be utilized along with or following surgical procedures for the correction of deformity of the upper jaw.

Deformities of the maxilla may be congenital or acquired. Cleft palate is the most common congenital deformity. Prostheses are of value when surgery results in failure or only partial success. After suc-

It is pointed out that if no substantial response is obtained at the end of 48 hours, further injection of penicillin is useless.

A series of 66 patients with hypopyon was treated with penicillin. There were 39 cases of infected corneal ulcer 18 of which were treated by subconjunctival injections of penicillin in doses of 50,000 units, with or without the application of penicillin ointment. Infected corneal ulcers responded well to treatment. Eighteen of 21 cases of infected corneal ulcer with hypopyon responded to subconjunctival injections. Hypopyon associated with herpetic or neuropathic keratitis gave no response. Hypopyon iris required no treatment other than atropine.

General sulfonamide therapy was used in 3 patients when subconjunctival injections of penicillin were inadequate. **JOSEPH ZUCKERMAN, M.D.**

Bilateral Uveitis from Horse Serum T F SCHLAGER, Jr. *Am J Ophth.* 1947 30 25

The author describes the development of bilateral granulomatous uveitis in rabbits after the use of normal horse serum.

In every case in which the right eyes of rabbits were injected with serum and later given repeated large doses intravenously the reaction was severe in the injected eyes and moderate in the uninjected.

The uvea revealed infiltration by lymphocytes, large mononuclear phagocytes, plasma cells, and epithelioid cells. Injected eyes developed replacement fibrosis and involvement of the retinas, whereas the infiltration in the unaffected eyes remained fresh and the retinas were not affected.

A second series of experiments was performed to elucidate the mechanism of this contralateral response. The rabbits received the original injection intracutaneously instead of into the right eye.

Not only the clinical but also the microscopic reactions in the uninjected eyes of the first series were significantly greater than the reactions in the uninjected eyes of the second series. The cause of this apparent superiority of the eye over the skin for predisposition to a reaction in uninjected eyes was not determined. **JOSEPH ZUCKERMAN, M.D.**

Penicillin Therapy of Experimental Infections of the Lens and Vitreous with Clostridium Welchii. LEON C. HOSKINS. *Arch. Ophth.* Chic., 1947 38 50

The author discusses penicillin therapy of infection of the eye by *Clostridium welchii*. Infections of this type which are relatively common among battle casualties are now effectively controlled by penicillin. Because penicillin iontophoresis failed to check infection of the lens by this organism, experimental infection of the lens and vitreous was undertaken.

Hoskins found that direct injection of penicillin into the lens and vitreous satisfactorily controlled infections with the *Clostridium welchii* if the therapy was instituted within 3 hours after the inoculation.

The results were less favorable when the interval between the infection and the treatment was increased to 6 hours.

In a series of 3 hour cases a beneficial effect was obtained with only moderate damage to the structures of the eye. **JOSEPH ZUCKERMAN, M.D.**

Dicummarol and Rutin in Retinal Vascular Occlusion. ARTHUR L. MACLEAY and CHAS. I. BRAMWELL. *Am J Ophth.* 1947 30 1043

The purpose of the authors was to present a concomitant use of dicummarol and rutin in vascular retinopathies. The mechanism of retinal vascular occlusion was presented as a slowing of the blood flow followed by the formation of a reorganized occlusion on the endothelium, upon which cells and fibrin are deposited so that an organized thrombus passes into the lumen of the vein. When dicummarol is administered orally the prothrombin activity of the blood is reduced and intravascular thrombus as well as intravascular coagulation is inhibited in this manner the enlargement of the clot by further fibrin deposition may be prevented. The potential thrombus, if its growth is checked, may leave a scar for the passage of blood. Rutin was used to decrease capillary fragility when present.

In this series of 35 cases dicummarol was given in doses to maintain a coagulative activity index of 50 per cent of the normal. In more than one-half of the cases rutin was usually given orally at the same time in 60 milligram doses daily. The dicummarol produced a minimum of untoward side reactions and no toxic manifestations were observed from the rutin.

The present series of cases of various retinopathies manifested a definite decrease in the prothrombin clotting time compared to normal controls. Dicummarol and rutin therapy in a case of tributary occlusion showed an increased rate of improvement, but in 6 cases of central vein occlusion the rate of recovery was variable. Four patients with diabetic retinopathy presented improvement of their visual acuity and absorption of hemorrhages when treated with dicummarol and rutin. The retinopathic condition manifested by macular and perimacular edema with attenuated vessels was cleared in a short time with rutin and dicummarol. Two patients with Eales disease were found to have a strongly positive Gollin Index and rutin alone produced improvement.

The primary etiological factor of degenerative retinopathy probably rests upon vascular sclerosis and the secondary process of thromboses. Dicummarol therapy produced an improvement in all cases of this type. **ROBERT H. JOHNSON, M.D.**

The Treatment of Traumatic Diplopia J. C. Voss *Brit. J. Ophth.* 1947 3 58

The author reports his findings concerning the incidence and causes of accommodative asthenopia and discusses the treatment of traumatic diplopia.

Before the war there was no recognized technique for correction of traumatic diplopia.

As far as the vertically acting muscles are concerned it is not necessary to obtain orthophoria in

cessful operations have been performed in infancy retraction of the upper middle half of the face and gross irregularities of the teeth often result. Artificial palates are of two types those which are movable and under control of the muscles of the soft palate, and those of the stationary type which form contact on their lateral and posterior surfaces with the muscles of the palate and pharynx. The movable appliance may leak air at the point of contact with its supporting denture and occasionally requires repair. The stationary denture creates more strain on supporting teeth and is not desirable in the absence of adequately sound teeth.

Retraction of the upper jaw is often seen in young adults because of a lack of underlying support of the alveolar bones. The Eastlander Abbe operation has given good results in those patients with an underdeveloped upper lip. The operation consists of a two-stage transfer of a measured triangular flap from the midline of the lower lip to the upper lip.

Acquired deformities occur as the result of injury or disease or by operative treatment for malignancy. Use of an immediate denture in operative defects prevents secondary contractions and adhesions of the soft tissue and contributes to the patient a comfort. Prosthetic appliances may be anchored to the remaining alveolar ridges, palate and teeth. Spaces leading to the nasal cavity may also be used as means of retention. It is sometimes advisable to incise adhesions of the mucous membrane and apply a skin graft within the oral or nasal cavities to give better membranous lining for toleration of the denture. Spiral springs with attachments from the lower jaw to the upper prosthesis are of some value when other methods of retention fail. Surgical measures are necessary to make the prostheses possible and should be made to harmonize with prosthetic procedures to be used in each case.

Ten case histories with excellent diagrams and photographs illustrating different types of prosthetic appliances are presented. JOHN R. LINCOLN, M.D.

Partial Denture Prosthesis for War Injuries. LOUIS EMORY. *J Am Dent Ass* 1947 35 634.

The surgical treatment of maxillofacial injuries has received a great deal of notice in the literature but, as the author of this report says, little or no reference has been made to the artificial restoration of lost parts of the jaw and face. The restoration of function and esthetic substitution for the lost parts is the duty of the well trained dentist, continually working hand in hand with the surgeon. The author emphasizes the necessity for the early combined efforts of these two but points out that a thorough understanding of the basic principles and engineering skill of the most exacting prosthodontic type are required and the work may perhaps require a long period of time. In other words no case is static and each one may require—more often than not—constant alteration not only to fit in with the changing surgical situation but also to assure comfort and to fulfill the functional requirements.

This article deals only with partial denture restorations. The illustrations and discussion give a clear, though concise, description of the conditions which may be encountered. The bibliography is fairly complete. WILLIAM G. SMITH, D.D.

NECK

Papillary Cystadenolymphoma. KAN-GUO LIAO. *Acta radiol., Stockh.* 1947, 26: 22.

Cystadenolymphoma occurs principally in elderly persons, their average age being about 60 years. The great majority of the patients have been men. This condition progresses slowly generally over a period of several years, and the tumor may become quite large. A differential diagnosis between this condition and other tumors of the parotid gland is most impossible. The diagnosis is made by microscopic examination. Most of these tumors have a distinct capsule and may be easily shelled out. Incurrences were noted in only 3 cases and the recurrence resembled the original tumor. No cases have shown malignant degeneration. Cystadenolymphoma has no typical macroscopic characteristics. The microscopic findings are highly characteristic, one portion being epithelioid degeneration and the other being lymphoreticular resembling a lymph node.

Nine case reports are presented in abstract. Two tumors had been observed primarily in the parotid area, only 5 were in the submandibular region and none was in the sublingual region.

RICHARD J. BECKETT, JR. M.D.

Simultaneous Chromaffin Tumors of the Carotid Body and the Glomus Jugularis. G. F. KIRK. *Arch. Path., Chic.* 1947 44: 15.

A case is presented in which there were multiple tumors arising in the chromaffin system. One tumor was found in the carotid body on the right side of the neck and the other tumor was found in the petrous portion of the temporal bone. This recently recognized body is known as the glomus jugularis. It appeared that the tumor of the petrous portion of the left temporal bone had been present for 50 years before the tumor of the right side of the neck was discovered.

In the report of the single case, there was nothing unusual in the physical examination except the tumors. Biopsy specimens taken before death showed a pathology similar to that of the tumor found post mortem. The tumor of the petrous portion of the left temporal bone would appear to have been present for at least 50 years since it was completely removed at the primary mastoidectomy.

RICHARD J. BECKETT, JR. M.D.

Intrinsic Cancer of the Larynx. Review of a Series of Cases. V. E. NIXON. *Proc. R. Soc. Med. Lond* 1947 40: 55.

Among 503 lesions of the upper portions of the respiratory and alimentary tracts, observed by the

author over a period of 20 years, 93 were intrinsic and 94 were extrinsic laryngeal cancers.

Of the intrinsic cancers 54 were unilateral (41 cordal, 7 subglottic and 6 supraglottic) and 39 were bilateral (10 limited and 29 diffuse). There were 20 males and 3 females. The ages of the patients ranged from 26 to 80 years the majority being from 40 to 60 years. Age had no apparent relation to the prognosis since the percentage of "cures" was similar in all age groups. The lesions were squamous cell carcinomas except for an epithelioma (Broders group 4) in 1 case. Seventy nine of the 93 patients were treated by the author.

The pathological sections of 42 lesions were graded according to Broders classification. Success is defined as absence of recurrence at the end of 5 years. Results were listed as promising if there was no recurrence during a period of observation of less than 5 years.

In group 1 there were 4 failures and 4 successes in group 2 9 failures and 14 successes in group 3 4 failures and 4 successes in group 4 3 failures (no successes).

Of 35 patients treated for unilateral cord cancer 20 were cured and in 11 patients the results were promising of 5 with unilateral subglottic growths 1 patient was cured and in 1 the results were promising of 5 patients treated for unilateral cordal and subglottic cancer, 1 patient was cured and the results were promising in 3 of 32 patients with bilateral intrinsic laryngeal cancer 7 were cured and in 7 the results were promising.

Laryngofissure laryngectomy and irradiation with interstitial radium, radium collar radium beam and deep x ray therapy were the methods of treatment. The type of treatment was selected according to the site and extent of the tumor.

After his experience of 20 years the author suggests that growths limited to the membranous vocal cord are best treated by laryngofissure. A unilateral cord growth extending to the posterior arytenoid cartilage or the posterior commissure is treated by external irradiation or interstitial radium. A diffuse growth should be treated by total laryngectomy.

CLAUDE H. THURMAN, M.D.

Methylthiouracil in the Treatment of Thyrotoxicosis. ARNE BARRER. *Am J Med Sc.* 1947 214: 349.

The first group of patients to be treated with methylthiouracil had iodine resistant thyrotoxicosis and were given large doses of the drug (1 gm. or more a day). Forty-four per cent developed such severe toxic reactions that the drug had to be discontinued but 7 per cent were treated successfully.

The second group of patients treated with this drug had not received iodine to any extent before the administration of methylthiouracil. In this group smaller doses of the drug were used and the authors now believe that the dose should not exceed 0.4 gm. a day. There were 43 patients in this group. In 5 or 12 per cent, the treatment had to be stopped because of toxic reactions, and in 37 or 86 per cent, the treatment was considered to be effective. The dosage was gradually decreased and when the patient had done well for a month on 0.05 gm. a day the drug was completely withdrawn usually after an average period of 5 months.

Of the patients effectively treated with methylthiouracil 36.4 per cent maintained a sustained remission after withdrawal of the drug and were considered cured of their thyrotoxicosis, while 27.2 per cent suffered a remission after withdrawal of the drug. Thus, in starting methylthiouracil treatment only one-fourth of the patients may be expected to be cured. Some of the author's cases were apparently methylthiouracil resistant cases.

The author concludes that methylthiouracil is a more powerful antithyroid drug than thiouracil, but that the toxic reactions of the two drugs appear to be about equal. He believes that antithyroid drugs are contraindicated in large intrathoracic goiters in large goiters causing pressure symptoms, in noncooperative patients, in thyrotoxicosis which are due to acromegaly and possibly in thyrotoxicosis associated with pregnancy. He found that the test for urobilin in a 1 to 10 dilution of urine was a particularly sensitive one for early toxicity, thus confirming other reports that liver damage is often one of the earliest signs of toxicity.

F J LEREMAN, JR., M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS CRANIAL NERVES

Bell's Palsy: Pathology and Surgery; A Report Concerning 50 Patients Operated on by the Method of Ballance and Ducl. KARSTEN KETTEL. Arch. Otolaryng. Chic., 947 46 487

Since 1932 when Ballance and Ducl began operating on patients with Bell's palsy by opening and decompressing the fallopian canal from the stylomastoid foramen to the lateral semicircular canal investigation as to the etiology pathology and therapy of this disease has actively progressed. The present study is based on observations made in 50 operative patients, with consideration to the pathogenesis of the condition and the value of the decompression operation.

Previously the gross and microscopic pathology of the facial nerve and the surrounding region has revealed alterations of the axis cylinders and medullary sheaths, usually greater in the peripheral portions. Occasionally degenerative changes were noted in the facial nuclei. Inflammatory changes have been rare. A few authors have found distinct alterations in the cells of the mastoid process along the facial canal and others have described edema of the facial nerve in instances of recent paresis and atrophy in chronic cases.

In the series of cases here summarized extensive bony necrosis of the mastoid cells was observed in 11 patients (20 per cent). In 5 this involved the entire cellular system and had been noted roentgenologically whereas in 6 it was found only in the apex of the mastoid process, especially about the region of the stylomastoid foramen. Microscopically there was slight osteoporosis and bony necrosis. There was no suggestion of any inflammatory process. The facial canal was grossly soft in 18 patients (36%) while in all of the others it appeared normal. In 28 patients (56%) the nerve was unquestionably edematous grossly in 2 it was possibly atrophic and in 1 patient the changes were so marked that nerve continuity was interrupted. In this instance microscopic examination revealed nerve trunk edema, fibrinous exudation, fresh hemorrhage and marked degeneration of the axis cylinders and medullary sheaths. There were remnants of a venous thrombosis in the nerve sheath.

Previous authors have suggested that Bell's palsy is due to an inflammation (a latent nonsuppurative otitis media) or an aseptic disturbance of the blood supply. Numerous observations support the theory that the genesis of this disease is due to a disturbance of the vasa nervorum and this theory is held by the author on the basis of his pathological and clinical studies. In the majority of cases the nerve, as the most susceptible tissue suffers alone in others the surrounding more resistant bone is affected. The

result is ischemic paralysis and ischemic myocrosis. All symptoms and findings are then explained by ischemia of the facial nerve and the mastoid region. The rapidity of paralysis and its progress depends upon the vessel size, degree of ischemia, or re-establishment of the circulation.

Since previous experience has shown that the great majority (from 85 to 95%) of the cases respond to conservative treatment, the problem arises as to which patients to select for operative intervention. The faradic reaction has been used by previous investigators as a reliable index, but the author does not concur in this opinion. Cases are cited in which a negative faradic response was obtained but complete recovery took place later. The author gives indications for the surgical treatment of Bell's palsy.

1 A decompression should be done in cases in which signs of beginning mobility have not appeared after an observation period of 2 months.

(Of 25 patients operated upon, 30 were ready for re-examination. Two had recovered completely. No patient showed any weakness when the face was at rest and all of the patients could close the eye completely and smile, but to a varying degree.)

2 A decompression should be done if the spontaneous recovery of mobility has ceased before complete restitution has been obtained.

(Of 17 patients operated upon, 13 were ready for re-examination. Nine patients showed improved mobility and 1 patient had recovered completely. One obtained relief from a contracture which had formed before operation. In 3 patients the procedure was of no benefit.)

3 Decompression is indicated in relapsing paresis.

Of 8 patients in this group 5 recovered completely and the mobility increased in all. The beneficial effect of decompression of the facial nerve in cases of Bell's palsy is believed to be due to improvement of the blood flow by release of pressure on the vasa nervorum or by the establishment of a collateral circulation. C. FREDERICK KETTEL, M.D.

SPINAL CORD AND ITS COVERINGS

Relations of Nerve Roots to Abnormalities of Lumbar and Cervical Portions of the Spine. J. J. KEEGAN Arch. Surg. 947 55 445.

Results of careful neurological observations are presented on 1155 cases of compression, infection, or section of single posterior nerve roots. Of these, 1,030 were in the lower extremity 583 being relieved by surgical intervention. Ninety-eight were in the cervical region, and 31 of these were treated surgically.

It is postulated that loss of a single nerve root produces an area of hypalgesia, in contrast to the previously accepted dictum that such a loss causes no sensory disturbance.

If vertebrae are counted in total numerical sequence and not arbitrarily defining region. C-5... lumbar region as bordered by the last rib and the sacral segment no alteration in the segmental distribution of nerve roots is noted despite the addition or fusion of vertebrae. This method of terminology is recommended for describing the location of areas of disk. A new dermatome chart of the upper and lower extremities is given based on hypodermic patterns from loss of a single nerve root. This does not support the usual anatomic teaching of cutaneous variation and forward transmutation of nerve roots. A few areas in the developing limb buds of the trunk, when added to the usual dermatome chart of the trunk, it presents an orderly sequence of innervation of skin areas in direct numerical relation to the nerve roots. (See Fig. 1)

C. FREDRICK KITTLE, M.D.

PERIPHERAL NERVES

Observations on the Treatment of Traumatic Injuries of the Peripheral Nerves. By ALVIN S. FRIEDLAND. *Bull. J. S. A.* 1941, 31, 37.

Two hundred and ninety-four patients with 330 peripheral nerve injuries incurred by war wound and related injuries were observed for periods up to 6 years. Unexpectedly favorable results were obtained by conservative treatment. This was improved by circumstances at first but was later pursued liberally.

Of the 330 patients recovered spontaneously 64 per cent, surgically 31 per cent were re-implanted. Of the last 1 per cent were subjected to radical amputation 6 per cent had damage beyond repair 16 per cent had some nerve tissue intact but subsequently recovered spontaneously. Let us due to projectiles showed a high incidence of spontaneous recovery. The incidence of paraplegia and injuries of the radial and ulnar nerves increased when the corresponding long line was in.

Three factors should all be considered as a catalyst in the treatment of peripheral nerve injury.

Degree of interruption of nerve conductance.

Duration of the latent period, the time required for the nerve to resume its function.

Appearance of the nerve at the site of injury.

The presence of neuroma or neuroma-like tissue.

Recovery of the nerve after the above factors have been considered.

It is apparent that the above factors are of great importance in the treatment of peripheral nerve injuries.

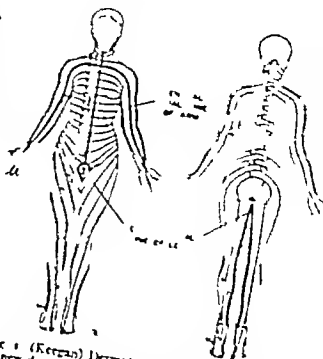


Fig. 1 (Keenan) Dermatome chart of the human body with new dermatome patterns of the extremities and the standard dermatome patterns of the trunk. Note the serial continuity of the dermatomes in the extremities and the trunk. (See p. 34 for abstract)

How Long Should an Extremity be Immobilized after Nerve Suture?

104-12-34

In the suture of a nerve, hands every nerve is with the use of various procedures of covering the gaps which result from the loss of substance of nerve or the retraction of their stumps. The method commonly used for gain length of the nerve is extensive freeing of the nerve, retaining it with the neurotony of the nerve. Even when these steps are taken it is sometimes necessary to introduce nerve grafts. It is the author's preference to the use of grafts, but that is not the line. In these instances, when the suture is not successful, the nerve is often anastomosed to a healthy nerve, usually the radial nerve. The period of immobilization is not too long, but it is not too short. It is the author's experience that the nerve should be immobilized for a period of 10 to 14 days. This is based on the fact that the nerve is not yet healed, but it is not too long to cause atrophy. The author's experience is that the nerve should be immobilized for a period of 10 to 14 days. This is based on the fact that the nerve is not yet healed, but it is not too long to cause atrophy. The author's experience is that the nerve should be immobilized for a period of 10 to 14 days. This is based on the fact that the nerve is not yet healed, but it is not too long to cause atrophy.

and then sutured by the use of the autologous plasma clot technique. Two of the 3 untwisted strands of No. 00 corticelli black silk were used as tension sutures to approximate the nerve ends, and accurate apposition was achieved with the aid of plasma clot. The animals were sacrificed at various intervals after operation, and 4 cm. segments of the nerve were removed (2 cm. to each side of the suture site). Also 4 cm. segments of intact sciatic nerve were excised. The silk tension sutures were removed and tensile strength measurements were made of the suture site, the intact nerve and of one of the withdrawn silk tension sutures from each nerve. For the purpose of microscopic study the same technique of nerve suture was used upon the sciatic nerves of dogs with the exception that tantalum wire (.003 inch in diameter) which causes less tissue reaction than silk, was used for tension sutures. Observations were made upon several hundred of such nerves at intervals ranging up to 18 months after operation. This material was prepared for study by a variety of histologic techniques.

The technique employed for the measurement of tensile strength was essentially that described by the author in a previous publication. Increasing increments of weights were applied until rupture of the nerve took place.

Histologic observations disclosed that a few monocytes and polymorphonuclear leucocytes appear within the plasma cuff as early as from 24 to 48 hours after nerve suture and an occasional fibroblast may be seen at this time. The fibroblasts increase in number and a normal epineurium is reconstructed from the plasma sheath in from 7 to 10 days.

As early as from 3 to 5 days after suture cells may be seen streaming across the suture line but occasionally signs of such cellular proliferation are strikingly absent. Sections taken 9 days after operation have shown structural continuity of schwannian and endoneural sheaths, although not uniformly in all cases. In practically all sutures 18 days or particularly 3 or more weeks old complete restoration of structural continuity has occurred. The growth of nerve fibers through the suture line may be demonstrated at this age.

Tensile strength determination confirmed that the suture site regained or even exceeded the strength of the intact sciatic nerve in 19, or more days after operation. The nerves appeared to achieve a greater tensile strength value at a certain time when their ends were accurately coapted and well joined. It appeared that the general condition of the animal too played a role in governing the rate of healing at the suture site. The microscopic observations in dogs indicate that this statement applied also to this species since structural continuity at the suture line was found to be complete at approximately this time. It seems justifiable then to advocate the removal of plaster of Paris encasements or other means of limb fixation 3 weeks after nerve suture and the institution of gradual extension of the joint at this time. There would be no danger of rupture of the suture

site in well made unions when a nerve is subjected to any strain 3 weeks after suturing. However, there is no doubt that there is a limit to which a nerve can be stretched and yet remain capable of recovery with resultant functional recovery of the severed part.

It is concluded that in those cases in which joints must be flexed in order to perform end-to-end union of nerves and the extremity encased in plaster, encasement may be removed 3 weeks later with danger of rupture of the suture site during its subsequent extension of the limb.

HOWARD H. LADD, M.D.

Rate of Regeneration of Sensory Nerve Fibers STURGEY SUNDERLAND. *Arch. Neurol. Psychiat.* 1947 58: 1

Although Tinel's sign has been frequently used in the estimation of rate of growth of peripheral nerves the reports have failed to specify or explain at what period of regeneration this sign has been investigated, or if repeated observations were made at varying intervals. The present report does not attempt to correlate the morphologic study of the regenerating nerve fiber with Tinel's sign, or to prognosticate the value of this sign.

The present study was derived from 11 guinea pigs with 12 peripheral nerve lesions. In 9 cases the suture was performed while in 3 cases the lesion was of the type defined as axonotmesis. It is concluded that nerve regeneration as evidenced by Tinel's sign does not progress at a steady rate but by a progressively diminishing rate. In the early stages (the first 100 days) there was a decline from 1.5 mm. per day (possibly 3 mm. in the very early phase) to 1 mm. per day. An intermediate stage of from 100 to 200 days revealed the growth rate at approximately 1 mm. per day. The terminal stage (from 200 to 300 days) showed a further definite drop from 0.8 to 0.5 mm. per day.

In a previous paper the author reported his study of the rate of regeneration of motor fibers by a completely different method from which it was assumed that the rate of growth was of functionally mature motor fibers. The fibers found in that group were very similar to the present group of sensory fibers, hence although the processes may not be similar there was no appreciable difference in the rates of advance of sensory or motor fibers as measured by dissimilar methods of investigation.

JACK I. WOOL, M.D.

SYMPATHETIC NERVES

Surgical Treatment of Hypertension. REEVES J. B. *Brit. Med. J.* 1947 45: 24

A report of the results obtained in 439 selected hypertensive patients treated by lumbar sympathectomy is made in this article. The possible causes of hypertension (increased peripheral resistance to the flow of blood through the arteries, in particular) are mentioned and the physiologic and

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Regeneration after Sympathectomy and Its Effect on Raynaud's Disease. H. A. HAXTON *Brit J Surg* 1947 35 69.

genic mechanisms behind these theories are out of the operative exposure including a paravertebral division from the ninth rib to the iliac crest with removal of portions of the eleventh and twelfth ribs. The division of the diaphragm is described. This allows the removal of the sympathetic trunk from the eighth thoracic to the first lumbar ganglia in a dissection but may be extended down to the second and third lumbar ganglia if necessary. The greater splanchnic is reacted down to the celiac ganglion from the midthoracic region. The operation is bilateral, and is done in two stages. The operation is bilateral in length, and a descriptive study are outlined at different types of hypertension.

The results have been determined on the basis of the amount of drop noted in the diastolic pressure. Group 1 includes those cases in which there was a drop of 20 millimeters or more and to below 90 mm. Group 2 includes those cases in which the diastolic pressure is lowered 20 millimeters or more but not to below 90 mm. Group 3 includes patients whose diastolic pressure was lowered less than 20 millimeters or who showed no change at all. Group 4 includes patients in whom the diastolic level and pulse pressure were essentially unchanged but the ceiling levels were lowered. Patients in group 5 showed no change in blood pressure. Those in group 6 had higher blood pressures. Those in group 7 died. Patients in groups 1, 2, and 3 are believed to have been benefited.

The results obtained in the 439 unselected cases are as follows: 65.8 per cent of the patients are improved, the condition in 21.8 per cent of the patients is unchanged, 6.8 per cent of patients show a higher level of blood pressure. Death occurred in 14.6 per cent of the patients. The cases have been followed up for periods of from 1 to 5 years.

Further "selected" cases are described and the criteria for operation in the various groups are outlined in detail. The results following surgery in 329 selected cases were as follows: 84.8 per cent of the patients were benefited, 11.6 per cent were unchanged, 4.4 per cent had higher blood pressures, 17 per cent of the patients died.

HOWARD A. BROWN, M.D.

To ascertain the completeness of a sympathectomy the author favors the use of the skin electrical conductivity test. Sweating skin conducts electricity more readily than dry skin and therefore has a low resistance. After a sympathectomy the affected area a resistance increases a hundredfold. If one wishes to examine the skin electrical conductivity of the body generally it will be an aid to place the person in an environment which encourages sweating. To test the extremities, however, this is unnecessary because the palmar surface of the digits is usually moist and can be readily tested without inducing sweating. The author believes this test to be much more delicate than the digital skin temperature. Tests have been done following various types of sympathectomies and the following illustrates the degree of anhidrosis occurring after each.

Section of the cervical chain produces anhidrosis of the affected side of the face, neck and upper thorax to below the clavicle. This corresponds to the distribution of the fifth cranial nerve and the first three cervical dermatomes.

Section of the thoracic sympathetic chain at the level of the third rib and at the upper end of the chain with division of the rami from the second and third thoracic nerves produces anhidrosis in the upper limb and in the upper thorax. Following surgery the hand is dry and warm but the temperature gradually drops until it is a few degrees above the preoperative level. The removal of a 3 to 6 cm. segment at the third lumbar level produces anhidrosis of the foot and leg except for a small strip above the middle malleolus.

To study the results of these operations, tests were done on 46 upper and 38 lower extremities from 1 to 14 years after surgery. In all the extremities examined with the exception of 7 lower extremities, some return of sympathetic activity was demonstrated. The patients' stories indicated that 18 of the upper extremities and 4 of the lower extremities had a recurrence of pain. The author believes that the relapse is due to a regeneration of sympathetic fibers and local sensitivity of the vessels to cold.

DANIEL ROOS, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Surgical Management of Large Defects of the Thoracic Wall HERNLE C. MAIER. *Surgery* 1947 33 169.

Large defects in the thoracic wall may result from the radical resection of tumors, from areas of radiation necrosis and from trauma. Although the chest wall may be extensively involved by infection destruction of the entire thickness over a large area is uncommon. If the loss of tissue of the thoracic wall involves only the skin, subcutaneous tissues, and extrathoracic muscles, the principles of management are similar to those followed when treating defects in other portions of the body. When the bony or cartilaginous structures are destroyed or removed over a considerable area, problems peculiar to the thoracic cage are encountered. If the defect extends into the pleural cavity the problem of an open pneumothorax must be met.

The resection of several ribs, cartilages, or a large segment of the sternum deprives that portion of the chest wall of its normal stability and results in paradoxical motion. The degree of abnormal mobility on respiration will vary with the location and extent of the defect, and will also be influenced by the thickness of the soft tissues and other factors such as the presence of pulmonary emphysema. If the resection of the lesion of the chest wall requires the sacrifice of the parietal pleura, a flap of tissue must be made available for an airtight closure of the opening. Skin grafting alone would obviously be inadequate in such cases.

Local recurrence of carcinoma following radical mastectomy for cancer of the breast may merit surgical excision if there are no evident distant metastases. The value of such secondary operations is considerably enhanced if the procedure is of a radical type. Often the entire thickness of the thoracic wall from the skin to and including, the parietal pleura should be excised. If the surgeon compromises in the extent of the excision in order to avoid a large defect or opening into the pleura, less satisfactory results will be obtained. When the resection includes the cartilages, ribs, intercostal structures and parietal pleura, a flap of skin and subcutaneous tissues down to the deep fascia should be mobilized from adjacent areas and swung over the defect as a pedicle flap. Since the tissues in the region of the previous mastectomy wound are rather fixed and somewhat fibrotic, this pedicle flap should be fashioned from tissue which was not in the field of the original mastectomy operation. A flap for the central part of the thoracic wall may be obtained by mobilizing the tissues forming the medial portion of the opposite breast.

By completely mobilizing the breast on the opposite side at its lower margin and to a considerable

extent along both the axillary and medial ends, the breast can be displaced considerably and maintain an excellent blood supply through its upper and axillary attachment. The defect closed by the displacement of the breast toward the opposite side of the anterior chest wall can usually be closed without tension by mobilization of the subcutaneous tissue in the lower axillary and upper abdominal areas. An additional incision may be required to permit a satisfactory advancement of the latter flaps.

The tissue of the anterior abdominal wall, the pedicle laterally, may be utilized for defects in the lower anterior thoracic region, and pedicle flaps from the axillary region may be used for the closure of defects in the lateral portion of the thoracic wall. If intensive radiation therapy followed the radical mastectomy the situation is more complicated.

Resection of a tumor of the chest wall often requires removal of the ribs, intercostal structures, and parietal pleura en masse over a considerable area.

Any repair of the thoracic wall which does not employ bony structures or periosteum from rib bone can regenerate fails to give an ideal result. Permanent paradoxical motion with respiratory bulging on coughing or straining may be avoided. Therefore, whenever possible periosteum or segments of rib or cartilage should be used in the closure of the defect. The employment of a foreign body such as tantalum plate has been satisfactory but cause proper anchorage and imbedding has proved feasible. It is difficult to immobilize a metal plate in a moving chest wall.

The most satisfactory repair of average size defects was obtained by using a periosteal flap developed from ribs immediately above and below the margin of the hernial orifice. In some cases ribs at the margin of the defect were cut tangentially and then displaced upward or downward and fixed to the rib stump of an adjacent partly resected rib. The displaced ribs helped to narrow the defect, and the periosteum from these ribs could be returned to its another to further lessen the space. These measures, however, could not be employed in some of the large defects that were encountered, and in such cases a closure which does not have the stability of the normal thoracic cage was obtained. If a large defect of the entire thickness of the thoracic wall was present, combined with an emphysema, a combination of thoracoplasty and the use of a full thickness flap of the chest wall was employed. A defect over the precordium was closed by making an intercostal incision through the full thickness of the chest wall lateral to the defect at its upper and lower margins. Because the paravertebral portion of the ribs of this area had previously been removed subperiosteally it was possible to slide this full thickness flap

the precordium and hold it in place by sutures. Because such a flap contains pericardium, later bone regeneration can occur and the chest wall may become firm in contrast to the flaccid chest wall when only a flap of soft tissue is employed.

Sexual Alteration of Advanced Cancer of the Breast. IKA T. NATHANSON, *Surg Clin N Amer*, 1947 27 1144

Evidence is presented showing the relation and effect of hormones on cancer of the breast. Successful responses have been obtained following gonadal therapy on the soft tissue manifestations of cancer primarily in elderly women. Androgen therapy on the other hand may favorably influence metastases in women of any age. Castration of most manifestations in premenopausal women gives responses are only temporary as reaction is the rule.

The administration of sex hormones or castration in carefully selected patients may be of value as a palliative measure when other methods are not feasible or as an adjunct to the orthodox procedures. The studies indicate that breast cancer may be dependent upon the endocrine status of the host. It appears therefore that the validity of the classic concept of autonomy of cancer cells must be questioned. The fact that alterations occur in breast cancer following sex hormonal administration or deprivation should lead to intensive investigation regarding the mechanism involved. If this is kept foremost in mind rather than the possibility that hormones may be a means of cancer therapy progress can be expected.

TRACHEA, LUNGS, AND PLEURA

A Study of Variations of the Bronchopulmonary Segments in the Left Upper Lobe. J. GORDON S. JONES, *J Thorac Surg* 1947 6 539

The left upper lobe bronchus usually bifurcates into a superior and an inferior (lingular) division (Fig 1). The upper division then divides into an anterior (B¹) and an apical posterior segmental bronchus (B² and B³). The anterior segmental bronchus (B¹) which reaches the interlobar fissure and adjacent costal surface and an anterior ramus (B⁴) which supplies the more anterior costal and mediastinal surfaces into an apical subsegmental bronchus (B⁵) and a posterior subsegmental bronchus (B⁶). The lingular inferior (B⁷) segmental bronchus. The principal variation in the left upper lobe centers about the development of an accessory anterior bronchus (B⁸), which is usually accompanied by a downward displacement of the anterior segmental bronchus (B¹) so that a pattern approaching trifurcation of the left upper lobe bronchus is



Fig 1 (Scannell). Injected specimen (No. 1) demonstrating prevailing pattern in series described by Lloyd and Hartmann. Costal surface on left, mediastinal view on right. B¹ failed to fill with the injection mass and is indicated by an asterisk. C = sternum (or lingular crest). C' = posterior crest. C'' = subclavian crest.



Fig 2. Injected specimen (No. 18) depicting trifurcate branching of upper lobe bronchus caused by downward displacement of anterior segmental bronchus, B¹, which then forms central limb of trifurcation an accessory segment, B⁸. Superior lingular bronchus, B⁷, is incomplete since its posterior ramus is absent and it lacks representation on costal surface B and B¹ were not injected separately in this specimen.

presented (Fig 4). Variations in composition of the anterior area of the left upper lobe are centered about the posterior ramus of the anterior segmental bronchus (B¹). This posterior ramus is often absent and the defect is remedied by compensatory expansion of the adjacent subsegments (B² and B³) or by the appearance of an accessory branch (B⁸). In the majority of instances of an absent B¹, the lingular segment (B⁷) supply the area involved. In the series of 13 specimens studied, only one showed a posterior segment (B⁷) extending upward to include the highest point of the lung. However, if the apex be considered as that portion of the lung lying above the plane of the first rib then 4 of the 13 specimens showed the posterior segment entering into the apex.

Intralobar Sequestration of the Lung Associated with an Abnormal Pulmonary Artery. D. M. FRY, T. HOLMES SELLERS, and L. G. BLAIR, *B J Surg* 1947 55 18. This article describes certain abnormalities in the vascular supply and anatomy of the lung which the

SAMUEL KALIN M D

surgeon may encounter at operation. Three types may be recognized (1) abnormal artery to the normally connected lung, (2) abnormal artery to a sequestered mass and adjacent normal lung, and (3) abnormal artery confined to the sequestered mass.

In spite of their origin from the aorta, these abnormal arteries are not bronchial arteries. Bronchial arteries are small and muscular but these vessels are large and have the elastic structure characteristic of pulmonary arteries. As the result of the higher blood pressure, these abnormal pulmonary arteries often show atherosclerotic changes.

The sequestration appears as a large cyst—a mass of polycystic lung connected with a dislocated blind bronchus at the hilum or a mass of lung with bronchi branching parallel with the abnormal artery.

Inflammatory changes occur and vary greatly and the clinical symptoms are all referable to infection which usually began early in life.

Diagnosis is difficult and usually a neoplasm is suspected. Roentgenography is of practical help.

The condition may be recognized at operation, which is usually undertaken for supposed bronchiectasis, cystic disease or empyema. Occasionally the condition is only identified on pathologic examination. Surgical excision is the appropriate treatment in view of the tendency toward infection.

The abnormality is obviously related to a lower accessory lung which may come from an extra lung bed or is a detached part of the developing lung. The sequestration may be complete or partial. The condition shows a preponderant tendency to occur on the left side, probably being associated with the bulging of the heart to that side.

The authors report 8 cases, narrating the history and course of this complex congenital condition.

STEPHEN A. ZIPMAN, M.D.

Experience with Thoracic and Thoracoabdominal Wounds in an Evacuation Hospital. S. A. MACLELLAN. *J. Thorac. Surg.* 947 6 33A.

Patients with wounds of the chest may be divided into 2 groups: those that require thoracotomy and those that do not. Of 285 patients with penetrating and perforating wounds of the thorax, 65 required thoracotomy. The indications for thoracotomy in the order of frequency with which they occurred are: (1) the anatomic likelihood of diaphragmatic penetration, (2) the presence of large intrapleural and intrapleural foreign bodies, (3) the presence of missiles in or traversing the mediastinum, (4) wounds of the large bronchi, and (5) continuing intrapleural hemorrhage.

Thirty-five of the 65 patients in whom thoracotomy was done required in addition exploration of the peritoneal cavity through the diaphragm. There were 5 deaths in this group of 65 patients—a mortality of 7.7 per cent.

Two hundred and twenty patients did not require thoracotomy. The general management of these wounds consisted of débridement, the prevention of

sucking by suturing the breach in the thoracic wall, and the evacuation of blood and air from the pleural cavity to obtain early expansion of the lung. Ten of these patients died, a mortality of 4.5 per cent.

Preoperative and postoperative care was directed toward the achievement of three basic aims: the restoration of respiratory equilibrium, the restoration of circulatory equilibrium, and the prevention of infection.

Respiratory distress was corrected by the maintenance of a clear tracheobronchial tree and by expansion of the lung by repeated thoracocentesis whenever necessary. The use of oxygen as an adjunct in the treatment was routine.

Circulatory imbalance was treated by the administration of citrated whole blood in an amount sufficient to give an adequate response. It was not unusual to administer from 1,000 to 1,500 cubic centimeters.

The factor of greatest importance in the prevention of infection during the postoperative period was the early obliteration of the pleural space by an expanded lung. This was achieved by repeated thoracocentesis. Penicillin was given intramuscularly in the amount of 25,000 units every 3 hours. This was begun on admission and continued until the lung was completely expanded.

SAMUEL KARR, M.D.

Traumatic Rupture of the Bronchus. THOMAS J. KIDWELL and L. W. JOHNSON. *J. Thorac. Surg.* 947 6 571.

Traumatic rupture of the bronchus occurs very rarely and is recognized clinically with even less frequency. At least 38 cases have been reported in the literature and 3 cases are added by the authors. The history in most cases is the same. The patients sustain a severe chest injury of a compression or crushing type; the ribs may not be fractured, and hemoptysis may not occur. Shock is usually profound. Marked dyspnea and cyanosis may develop if a tension pneumothorax occurs; hemothorax and subcutaneous emphysema may appear. The condition occurs at all ages, usually in males.

The exact mechanism by which the lesion occurs is not always clear. Apparently a severe shearing force is brought to bear upon the bronchus, causing it to rupture. The point most likely to tear is the main bronchus, within a few centimeters of the trachea. The right and left sides are involved with equal frequency. Rupture of the lung itself is not usually found in association with rupture of a bronchus, nor are the arteries and veins of the pulmonary hilum injured as often as would be expected.

Following the bronchial tear a pneumothorax of varying extent develops in about 40 per cent of all cases. Complete or nearly complete bronchial occlusion occurs with the development of a marked atelectasis of the involved lung, followed by an extremely marked shift of the heart and mediastinum toward the affected side, producing the dyspnea, chest discomfort, and other symptoms of which the patient is subsequently complain. If the obstruction

is not complete secondary bronchiectasis and inflammatory changes are likely to ensue.

The first therapeutic considerations should be the administration of oxygen to correct the anoxemia the administration of blood and plasma to combat shock and hemorrhage the aspiration of air from the pneumothorax side to relieve intrathoracic tension and incision if necessary, to relieve tension from mediastinal emphysema. If rib fractures are present sedatives or novocain block may be found of distinct value.

Early bronchoscopy should be done if the patient's condition permits it. If blood clots are present they should be removed in order to relieve atelectasis.

The condition may be amenable to surgical treatment. The risk of exploration may be slight as compared to the risk of doing nothing. The suture of an incompletely torn bronchus at the site most often affected should not prove to be too difficult. Even suture of a complete rupture of the bronchus, with the pulmonary and bronchial vessels intact, may also be possible. If a stricture results and the entire lung becomes atelectatic, a therapeutic pneumothorax on the affected side may relieve the symptoms and hold the mediastinal structures at or near the midline.

Patients who have an incomplete bronchial obstruction with infection will eventually develop bronchiectasis and infection in the lung distal to the stenosis. In such cases, pulmonary resection should be considered. Mediastinal shift, and overexpansion of the contralateral lung will be less following total pneumonectomy than from the atelectasis due to the bronchial stenosis as the fluid and coagulum which fill the pleural space after pneumonectomy occupy more space than the atelectatic lung which has been removed.

SAMUEL KAHN, M.D.

Pneumonectomy for Chronic Suppurative Emphysema (Neumonectomia por sepsis cronica del pulmon). JUAN C. BIDART, MALINER and JOSE GALARCE. *Bol. Acad. argent. cir.*, 1947 31 373

This article is principally a report of a chronic non-tuberculous lung abscess treated successfully by pneumonectomy. It occurred in a 39 year old male, who gave a 6 months history of the disease and had failed to respond to conservative management.

An excavating neoplasm was suspected of course and thoracotomy carried out. The gross findings at operation were compatible with neoplasm and a pneumonectomy by individual ligation technique was performed.

The postoperative course in this case was complicated by extensive breakdown of the wound in the chest wall as a result of infection. It is anticipated that a thoracoplasty will be performed. No neoplasm was found in the resected specimen. There was instead a suppurative process containing a well defined abscess cavity.

The justification for resection in chronic pulmonary suppuration is briefly discussed.

HIRSH T. LAROSTOM, M.D.

Pulmonary Cysts, with Special Reference to Surgical Treatment of Emphysematous Blebs and Bullae. ENRIK NACLERIO and LAZARO LANORA. *Surgery* 1947 22 516

Although the precise mechanism of the genesis of pulmonary cysts is unknown. It is believed that they originate from some developmental anomaly. There are three probable origins: congenital bronchiectasis, dilatation of lymphangiomatous spaces, and aberrant lung tissue or vestigial structures.

The manner in which a bleb is formed is similar to that in which interstitial emphysema occurs. There is a rupture of the wall of an alveolus which allows air to escape into the alveolar layer of the pleura.

In the case of bullae the alveoli are first dilated then atrophy and rupture of the alveolar wall occur. Various sized bullae gradually form which communicate with a bronchiole or a larger division of the bronchial tree. When blebs are present, the pleura is separated by the air from the underlying alveolar walls. When bullae occur the pleura retains its connection with the lung although the alveoli beneath them produce the bullae through rupture and fusion. The bullae can be considered best as an advanced stage of a localized pulmonary emphysema.

Since blebs and bullae are often associated with marked emphysema the clinical picture may be that of the latter condition only. The symptoms depend on the size, location, valvular mechanism, and condition of the contiguous lung parenchyma, and changes that may occur in the intrathoracic pressure. Infection is rarely seen in blebs and bullae although cysts of other types are prone to infection and produce symptoms of pulmonary suppuration. Blebs and bullae may remain symptomless for long periods and become distressing only when they are very large. Dyspnea may then become a prominent symptom and cough, expectoration and pain in the chest may appear. Occasionally a spontaneous pneumothorax may result from the rupture of a bleb or bulla.

Pulmonary blebs and bullae, even when large may be asymptomatic, and may be discovered only on x ray examination. They often disappear spontaneously. When severe and incapacitating respiratory symptoms appear operative procedure may be necessary.

Ten cases are reported: 5 of pulmonary emphysematous cysts, 3 of bullae, 1 of bleb and 1 of chronic interstitial emphysema involving the entire left lower lobe and the surgical procedure used in excising the involved area is described.

SAMUEL KAHN, M.D.

Malignant Lymphoma of the Lung and Pulmonary Coccidioidomycosis. EDWARD D. CHURCHILL. *Surg. Clin. N. America* 1947 27 1113.

Churchill reports a successful operative case of malignant lymphoma of the lung in a 45 year-old woman whose only complaint was aching pains in the right shoulder for over 20 years. Objective symptoms revealed little, and only after careful x ray

studies was the lesion in the upper right lobe of the lung considered operative. Because the middle lobe was fused with the upper lobe the two parts were removed after separate ligation and division of the hilar structures.

Röntgen therapy was instituted early. The patient made an uneventful recovery and is living with no evidence of the disease 6 months after operation.

A second case discussed was that of a 14 year-old boy with a baffling lesion in the upper left chest. After conservative methods failed surgery was undertaken. An immediate frozen section revealed a chronic inflammation probably coccidioidomycosis. The entire left lung with exception of the lingula was removed. After operation coccidioides were found in the sputum previously they had had no free access to the bronchus as the whole upper lobe on pathologic sectioning showed consolidation with only a few lung markings remaining.

STEPHEN A. ZIDMAN, M.D.

Primary Cancer of the Lung. ALTON OCHSNER, MICHAEL DEBAKEY and J. LEONARD DIXON. *J. Am. M. Ass.* 9:17 135 3

Within the past few decades two well established and generally accepted concepts of primary cancer of the lung have been completely disproved. One is the concept that carcinoma of the lung represents the rarest form of cancer. It now appears that lung cancer is one of the most frequently encountered neoplasms, being preceded only by cancer of the stomach. The other and more important concept disproved is that pulmonary cancer is a hopeless condition.

This is a review of 412 cases of cancer of the lung observed at Tulane University School of Medicine service in the Charity Hospital of Louisiana at New Orleans and in private practice at the Ochsner Clinic over a period of approximately 13 years. Of the 412 patients 246 underwent surgical exploration and of the 246 147 were subjected to primary pulmonary resection. An analysis of the experience with these patients with particular emphasis on the follow-up study on all patients who were submitted to primary resection is given. (This is essentially the same data, with 18 added resected cases, as that presented by Ochsner, DeBakey and Dixon in the *Annals of Surgery* (1947 185 538) and abstracted in *INTERNATIONAL ABSTRACTS* (1947 85 459).

Thirteen and six tenths per cent of the cancers occurred in women and 86.4 per cent in men. The fifth, sixth, and seventh decades were the most frequent time of appearance of the carcinoma. The etiology is obscure and both occupation and smoking previously particularly emphasized, were found to have no special significance in this analysis.

The most common early symptom is cough which is significant when any change in type of cough occurs and the change persists, particularly over a period of more than 3 or 4 weeks. Physical observations are extremely variable and depend upon the location of the carcinoma.

The most important factor in diagnosis is the consideration of the possible presence of cancer. Primary cancer of the bronchus should be suspected in every person over 40 years of age who has unexplained thoracic discomfort, a persistent cough, or hemoptysis. This is the key to increasing early diagnosis. Abscesses of the lung which cannot be satisfactorily explained in any man past 40 should be considered carcinoma until disproved. (The diagnosis of pulmonary abscess was the most frequent error encountered—5.4%.)

Röntgenographic examination is accurate initially in 83.5 per cent of the cases. Bronchoscopic examination with biopsy is the most accurate with positive diagnoses in 81.4 per cent of 74 cases in which biopsy was obtained among the 125 cases subjected to bronchoscopy. Thus a positive diagnosis was obtained by bronchoscopic biopsy in 41.5 per cent of 147 cases.

The lesion is located in the upper lobe in 49 per cent of the cases. Cytologic examination is particularly adapted to the verification of tumors in this location. Aspiration biopsy is condemned on the basis that implantation may occur along the site of the aspirating needle and thus preclude cure of the carcinoma. Exploratory operation should always be carried out for any unexplained thoracic complaint in a man past 40 years of age in whom the existence of bronchogenic neoplasm cannot be otherwise disproved or verified.

Extirpation of the tumor offers the only chance of cure. Pneumonectomy is the procedure of choice. The anterior approach is preferred.

The data indicate that for every 3 cases of pulmonary cancer 2 will appear to be operable and only 1 case will prove to be resectable. Both operability and survival rates are improving when statistics made prior to 1942 are compared with those made after 1942. The hospital mortality prior to 1942 was 46.4 per cent. It is now 19.3 per cent. Hospitalization has decreased from 32.3 days prior to 1942 to 13.5 days since 1942. Cardiovascular lesions account for 47 per cent of the hospital fatalities.

Survival rates drop rather rapidly within the first 3 postoperative years but by the third year become stabilized and continue almost as a plateau until the fifth year. This means that the five year survival of approximately one-fourth of the patients (23.5%) is approximately that of the 3 year survival rate.

A summary of operability and survival rates for all carcinomas of the lung according to these statistics would mean that 60 per cent of the patients meet the criteria for operability, 36 per cent could prove resectable, 18 per cent would survive the operation and 8 per cent would survive 5 years or longer.

The need for earlier diagnosis is readily seen if one reflects that should all cases be resectable when first seen then on the basis of present performance 50 per cent of the patients with carcinoma of the lung might be expected to survive 5 years or longer.

FRANK B. QUINN, M.D.

Induction of Bronchogenic Carcinomas in Mice.
E. S. HORMING. *Lancet* Lond., 1947 2 307

The author presents a preliminary report in which he describes the technique of inducing tumors by the direct application of carcinogenic compounds sometimes in combination with synthetic hormones, to adult lung tissue growing as homologous grafts in host animals.

Small pieces of adult lung are isolated under a dissecting microscope and impregnated with a few crystals of 30-methylcholanthrene. On placing the carcinogen in direct contact with the tissue to be grafted care is taken to wrap the tissue around the crystals so that they are shielded from contact with the tissues of the host. The grafts are implanted subcutaneously with a Bashford transplanting needle on each side of the belly of the host. As many as six subcutaneous primary grafts have been made in a single mouse. In all cases the graft tissue was taken from mice aged 3 months, belonging to the same strain as the hosts in which the grafts were to be implanted.

The host mice, bearing lung grafts, were mice of strains A and C3H which received lung implants impregnated with methylcholanthrene and were killed after an interval of 6 to 8 weeks, before malignant tumors had developed. The grafts were fixed for histologic study of early phases of carcinogenesis.

The pulmonary tumors were induced in both male and female mice, the incidence being about equal in the two sexes. The malignancy of the tumors was proved in all cases by transplanting portions of the primary tumor into mice of the same strain. All the transplants grew and some of these tumors are now in the third and fourth generations of transplantation. Grafts which did not develop tumors had become necrotic, presumably because of failure of vascularization.

In mice of strain C3H the tumor incidence was increased if the lung grafts were impregnated with stilbestrol in addition to the carcinogen.

The several advantages in this method of tumor induction are that the carcinogen is placed in direct contact with the living cells of the graft without the use of a solvent, and therefore there is little or no foreign body reaction or residue of necrosis, which might mask or conceal areas in which neoplastic changes first arise. Since the focus of activity of the carcinogen is within a graft and not in some part of a large organ the growth of the affected tissues may be more readily observed macroscopically and more easily removed for histologic examination of the early stages. The neoplasms arise in subcutaneous grafts and are maintained by subcutaneous transplantation. A series of grafts established in one host can be regarded as growing under identical hormonal conditions.

STEPHEN A. ZICKMAN M.D.

Bronchogenic Carcinoma. VIKTOR OLOV BJÖRK
Acta chir scand 1947 95 Supp. 123.

The author presents an admirable summary of facts obtained from an analysis of 345 cases of clin-

ically diagnosed bronchogenic carcinoma. The patients were treated at the Brompton Hospital for Diseases of the Chest and at the Royal Cancer Hospital (Free) in London during the period from 1937 to 1946.

The clinical findings were as follows: 90 per cent of patients were males and 10 per cent were females; 98.3 per cent of the patients were 30 years of age or over; 87.8 per cent were 40 years or over; the peak being from 50 to 54 years; 58.8 per cent of the lesions were located in the upper lobe and 38.4 per cent in the lower lobe. In 53 per cent of the cases there was a slight right predominance which corresponds to the normal values of weight and volume determination in which the right lung represents from 53 to 54 per cent. Pathological analyses were: squamous cell carcinoma 50.2 per cent; oat cell carcinoma, 14 per cent; undifferentiated carcinoma, 15.7 per cent; adenocarcinoma 9.2 per cent; and mixed adenocarcinoma and squamous cell carcinoma 9.9 per cent.

The anatomic classification of these tumors is as follows: central tumors, 65 per cent; intermediate tumors, 23 per cent; peripheral tumors, 12 per cent. No relation was observed between the histology and (a) localization, (b) duration of symptoms, (c) time of appearance of metastases or method of spread.

In women a relative predominance of adenocarcinoma (25%) was observed as compared to a 9.2 per cent incidence of all bronchogenic cancers in both men and women.

The most important symptom was a dry persistent cough lasting for a period of more than 4 weeks. Hemoptysis or pain both relatively late symptoms bring the patient to the doctor.

The methods of diagnosis were as follows: biopsy by bronchoscopy was done in 59 per cent of the cases; thoracotomy was carried out in 17 per cent; lymph node biopsy in 10 per cent; autopsy in 6 per cent; examination of sputum in 4.7 per cent of the cases; miscellaneous methods were used in 3.4 per cent. A total of 7.5 per cent of the tumors were operable (operability has been increased to 13.5 per cent since 1944). Operation could be completed in 49 per cent of the patients on whom thoracotomy was performed. Widening of the carina is not considered a contraindication to exploration since this may be occasioned by inflammatory enlargement of the lymph nodes at the bifurcation and may not be due to metastases. Only 21 per cent of enlarged hilar nodes were due to metastases; 79 per cent were purely inflammatory. Pneumonectomy with use of the dissection technique and closure of the bronchus by one row of isolated subterminal linen sutures and one continuous linen suture with a pleural flap is the operation of choice except in rare instances in which lobectomy is desirable for palliative reasons. Chemotherapy is used 2 days before and 1 week after operation. Preoperative pneumothorax is not useful.

In the present series the hospital mortality was 30 per cent. The primary mortality following the last 25 pneumonectomies was 8 per cent.

studies was the lesion in the upper right lobe of the lung considered operative. Because the middle lobe was fused with the upper lobe the two parts were removed after separate ligation and division of the hilar structures.

Röntgen therapy was instituted early. The patient made an uneventful recovery and is living with no evidence of the disease 6 months after operation.

A second case discussed was that of a 14 year-old boy with a baffling lesion in the upper left chest. After conservative methods failed surgery was undertaken. An immediate frozen section revealed a chronic inflammation probably coccidioidomycosis. The entire left lung with exception of the lingula was removed. After operation coccidioides were found in the sputum previously they had had no free access to the bronchus as the whole upper lobe on pathologic sectioning showed consolidation with only a few lung markings remaining.

STEPHEN A. ZIEGLER, M.D.

Primary Cancer of the Lung. ALTON OCHSNER, MI
CHARL DEBAKEY and J. LEONARD DIXON. *J. Am. M. A.*
1947 947 35 3

Within the past few decades two well established and generally accepted concepts of primary cancer of the lung have been completely disproved. One is the concept that carcinoma of the lung represents the rarest form of cancer. It now appears that lung cancer is no of the most frequently encountered neoplasms being preceded only by cancer of the stomach. The other and more important concept disproved is that pulmonary cancer is a hopeless condition.

This is a review of 411 cases of cancer of the lung observed at Tulane University School of Medicine served in the Charity Hospital of Louisiana at New Orleans and in private practice at the Ochsner Clinic over a period of approximately 12 years. Of the 411 patients, 246 underwent surgical exploration and of the 246 47 were subjected to primary pulmonary resection. An analysis of the experience with these patients with particular emphasis on the follow-up study on all patients who were submitted to primary resection is given. (This is essentially the same data, with 18 added resected cases, as that presented by Ochsner, DeBakey and Dixon in the *Annals of Surgery* (1947 125 528) and abstracted in *INTERNATIONAL ABSTRACTS* (1947 85 459).)

Thirteen and six tenths per cent of the cancers occurred in women and 86.4 per cent in men. The fifth, sixth and seventh decades were the most frequent time of appearance of the carcinoma. The etiology is obscure and both occupation and smoking previously particularly emphasized were found to have no special significance in this analysis.

The most common early symptom is cough, which is significant when any change in type of cough occurs and the change persists, particularly over a period of more than 3 or 4 weeks. Physical observations are extremely variable and depend upon the location of the carcinoma.

The most important factor in diagnosis is the consideration of the possible presence of cancer. Primary cancer of the bronchus should be suspected in every person over 40 years of age who has unexplained thoracic discomfort, a persistent cough, or hemoptysis. This is the key to increasing early diagnosis. Abscesses of the lung which cannot be satisfactorily explained in any man past 40 should be considered carcinoma until disproved. (The diagnosis of pulmonary abscess was the most frequent error encountered—5.4%.)

Röntgenographic examination is accurate initially in 83.3 per cent of the cases. Bronchoscopic examination with biopsy is the most accurate with positive diagnoses in 82.4 per cent of 74 cases in which biopsy was obtained among the 245 cases subjected to bronchoscopy. Thus, a positive diagnosis was obtained by bronchoscope biopsy in 41.5 per cent of 147 cases.

The lesion is located in the upper lobe in 49 per cent of the cases. Cytologic examination is particularly adapted to the verification of tumors in this location. Aspiration biopsy is condemned on the basis that implantation may occur along the site of the aspirating needle and thus preclude cure of the carcinoma. Exploratory operation should always be carried out for any unexplained thoracic complaint in a man past 40 years of age in whom the existence of bronchogenic neoplasm cannot be otherwise disproved or verified.

Extirpation of the tumor offers the only chance of cure. Pneumonectomy is the procedure of choice. The anterior approach is preferred.

The data indicate that for every 3 cases of pulmonary cancer 2 will appear to be operable and only 1 case will prove to be resectable. Both operability and survival rates are improving when statistics made prior to 1942 are compared with those made after 1942. The hospital mortality prior to 1942 was 46.4 per cent. It is now 19.3 per cent. Hospitalization has decreased from 32.3 days prior to 1942 to 13.5 days since 1942. Cardiovascular lesions account for 47 per cent of the hospital fatalities.

Survival rates drop rather rapidly within the first 3 postoperative years but by the third year become stabilized and continue almost as a plateau until the fifth year. This means that the five year survival of approximately one fourth of the patients (23.5%) is approximately that of the 3 year survival rate.

A summary of operability and survival rates for all carcinomas of the lung according to these statistics would mean that 60 per cent of the patients meet the criteria for operability 36 per cent would prove resectable 18 per cent would survive the operation and 8 per cent would survive 5 years or longer.

The need for earlier diagnosis is readily seen if one reflects that should all cases be resectable when first seen, then on the basis of present performance 20 per cent of the patients with carcinoma of the lung might be expected to survive 5 years or longer.

FRANK B. QUEEN, M.D.

Induction of Bronchogenic Carcinomas in Mice.
E. S. HORMING. *Lancet* Lond. 1947 2 307

The author presents a preliminary report in which he describes the technique of inducing tumors by the direct application of carcinogenic compounds sometimes in combination with synthetic hormones to adult lung tissue growing as homologous grafts in host animals.

Small pieces of adult lung are isolated under a dissecting microscope and impregnated with a few crystals of 30-methylcholanthrene. On placing the carcinogen in direct contact with the tissue to be grafted care is taken to wrap the tissue around the crystals so that they are shielded from contact with the tissues of the host. The grafts are implanted subcutaneously with a Bashford transplanting needle, on each side of the belly of the host. As many as six subcutaneous primary grafts have been made in a single mouse. In all cases the graft tissue was taken from mice, aged 3 months, belonging to the same strain as the hosts in which the grafts were to be implanted.

The host mice, bearing lung grafts, were mice of strains A and C3H which received lung implants impregnated with methylcholanthrene and were killed after an interval of 6 to 8 weeks, before malignant tumors had developed. The grafts were fixed for histologic study of early phases of carcinogenesis.

The pulmonary tumors were induced in both male and female mice, the incidence being about equal in the two sexes. The malignancy of the tumors was proved in all cases by transplanting portions of the primary tumor into mice of the same strain. All the transplants grew and some of these tumors are now in the third and fourth generations of transplantation. Grafts which did not develop tumors had become necrotic, presumably because of failure of vascularization.

In mice of strain C3H the tumor incidence was increased if the lung grafts were impregnated with stilbestrol in addition to the carcinogen.

The several advantages in this method of tumor induction are that the carcinogen is placed in direct contact with the living cells of the graft, without the use of a solvent, and therefore there is little or no foreign body reaction or residue of necrosis which might mask or conceal areas in which neoplastic changes first arise. Since the focus of activity of the carcinogen is within a graft and not in some part of a large organ the growth of the affected tissues may be more readily observed macroscopically and more easily removed for histologic examination of the early stages. The neoplasms arise in subcutaneous grafts and are maintained by subcutaneous transplantation. A series of grafts established in one host can be regarded as growing under identical hormonal conditions.

STEPHEN A. ZIEGLER M.D.

Bronchogenic Carcinoma. VIKTOR OLOV BJORX
Acta chir scand 1947 95 Supp. 123.

The author presents an admirable summary of facts obtained from an analysis of 345 cases of clin-

ically diagnosed bronchogenic carcinoma. The patients were treated at the Brompton Hospital for Diseases of the Chest and at the Royal Cancer Hospital (Free) in London during the period from 1937 to 1946.

The clinical findings were as follows: 90 per cent of patients were males and 10 per cent were females; 98.3 per cent of the patients were 30 years of age or over; 87.8 per cent were 40 years or over; the peak being from 50 to 54 years; 58.8 per cent of the lesions were located in the upper lobe and 38.4 per cent in the lower lobe. In 53.2 per cent of the cases there was a slight right predominance which corresponds to the normal values of weight and volume determination in which the right lung represents from 53 to 54 per cent. Pathological analyses were: squamous cell carcinoma 50.2 per cent; oat cell carcinoma 24 per cent; undifferentiated carcinoma 15.7 per cent; adenocarcinoma 9.2 per cent; and mixed adenocarcinoma and squamous cell carcinoma 0.9 per cent.

The anatomic classification of these tumors is as follows: central tumors, 65 per cent; intermediate tumors, 23 per cent; peripheral tumors, 12 per cent. No relation was observed between the histology and (a) localization (b) duration of symptoms (c) time of appearance of metastases or method of spread.

In women a relative predominance of adenocarcinoma (25%) was observed as compared to a 9.2 per cent incidence of all bronchogenic cancers in both men and women.

The most important symptom was a dry persistent cough lasting for a period of more than 4 weeks. Hemoptysis or pain both relatively late symptoms bring the patient to the doctor.

The methods of diagnosis were as follows: biopsy by bronchoscopy was done in 59 per cent of the cases; thoracotomy was carried out in 17 per cent; lymph node biopsy in 10 per cent; autopsy in 6 per cent; examination of sputum in 4.7 per cent of the cases; miscellaneous methods were used in 3.4 per cent. A total of 7.5 per cent of the tumors were operable (operability has been increased to 13.5 per cent since 1944). Operation could be completed in 49 per cent of the patients on whom thoracotomy was performed. Widening of the carina is not considered a contra-indication to exploration since this may be occasioned by inflammatory enlargement of the lymph nodes at the bifurcation and may not be due to metastases. Only 21 per cent of enlarged hilar nodes were due to metastases; 79 per cent were purely inflammatory. Pneumonectomy with use of the dissection technique and closure of the bronchus by one row of isolated subterminal linen sutures and one continuous linen suture with a pleural flap is the operation of choice except in rare instances in which lobectomy is desirable for palliative reasons. Chemotherapy is used 2 days before and 1 week after operation. Pre-operative pneumothorax is not useful.

In the present series the hospital mortality was 30 per cent. The primary mortality following the last 25 pneumonectomies was 8 per cent.

Of all patients operated upon and followed up (79) 5 per cent are alive longer than 5 years, 16 per cent are alive longer than 3 years, 23 per cent, longer than 2 years, 39 per cent longer than 1 year. The histologic differentiation of the cancer has no influence upon survival.

All inoperable tumors without contraindication should be treated by deep x rays. One 5 year survival has thus been secured. Untreated patients with carcinoma of the lung do not survive longer than 1 year after diagnosis. Contraindications to deep x ray treatment consist of poor general condition, extrathoracic metastases, large (but not small) pleural effusions, and well defined rounded tumor.

Postoperative deep x ray therapy is of value only in cases in which it is possible to exactly localise the area for treatment.

Deep therapy consists of 4,000 roentgens, or more, delivered through multiple small x ray fields applied from two opposing parallel planes on either side of the thorax with 4 fields applied to each plane each day, the position of the field being changed to an intermediate position on alternate days. By this means 250 per cent to 300 per cent of the dose given to any point of the skin may be delivered to the bronchial carcinoma. Ninety-two patients were so treated (excluding those in stage 4 with extrathoracic metastases). Complete relief of symptoms was obtained in 11 per cent, there was improvement in 46 per cent, no change in 19 per cent, and the condition became worse in 24 per cent.

This article contains the best factual summation of information on pulmonary carcinoma which this reviewer has encountered to date.

FRANK B. QUEEN, M.D.

Pulmonary Function after Pneumonectomy and Lobectomy. G. BRATHE, C. CRAWFORD, and P. RUDSTAM. *J. Thorac. Surg.* 1947 6 49.

Following pneumonectomy the total lung volume is somewhat less reduced than would be expected from the corresponding loss of parenchyma. In the position of maximum inspiration the remaining lung tissue is, therefore, exposed to increased distension. The distension of the lung tissue is especially marked in the respiratory midposition for in the equilibrium position the lung volume is approximately 50 per cent greater after pneumonectomy than can be expected from calculation.

After pneumonectomy and lobectomy the share of the residual and equilibrium capacities in the total capacity is clearly increased. This indicates a reduction of the respiratory efficiency. There occurs also an increase in the respiratory dead space, due probably to the increased lung inflation and to a certain extent, to emphysema.

Postoperatively dyspnea steadily diminishes and causes very little difficulty. If after lobectomy and pneumonectomy emphysema develops in the course of years, it appears to remain within moderate limits and not to encroach upon the lung function to any important degree.

SAMUEL KARRY, M.D.

Empyema Thoracis in Infants and Children. ALFRED E. CHAPLIN. *Arch. Dis. Childh.*, Lond., 1947 22 9.

A study of empyema thoracis in infants and children, covering two 5 year periods (1934-1938 and 1940-1944) was undertaken with a view of comparing the effect of sulfonamide therapy upon the incidence of the disease. A third group of cases consisting of 31 infants treated with penicillin since 1945 is discussed to illustrate the progress which has been made in the management of the disease in a most susceptible age group—the first 2 years of life.

During the period from 1934 to 1945 the author observed a reduction in the incidence of pneumococcal and streptococcal empyema in children and infants, and a reduced incidence of staphylococcal empyema in children of 2 to 14 years. Little or no reduction was observed in the number of cases of empyema or in the mortality figures for children from 0 to 2 years of age. Staphylococcal infections were observed as frequently as pneumococcal infections, if not slightly more frequently in the group from 0 to 2 years of age. The average mortality rate for all bacterial types of infection was 64 per cent for children 0 to 2 years of age.

It was concluded that penicillin plays an important part in the treatment of acute empyemas due to sensitive organisms. Penicillin may be injected parenterally and intrapleurally with aspiration of the pleural pus. Instillation of an adequate dose of penicillin every 2 to 3 days may produce complete resolution of the empyema in infants up to 2 years of age. From 2 years onwards, however, success with treatment by this method is unlikely unless the empyema is small. Aspirations are controlled by frequent radiographic examinations. Should the patient be slow to respond, and in the event of development of a thickened pleura surgical drainage is indicated. Similar interference is indicated in cases in which fibrin in the pus prevents adequate removal by aspiration. The intrapleural injection of penicillin should produce sterility of the pleural sac after one or two aspirations.

Rapid recovery with shortened convalescence occurred in both groups of infants—i.e. with and without surgical drainage.

STEPHEN A. ZIEGLER, M.D.

Discussion on Treatment of Nontuberculous Empyema. R. C. BROCK, and T. HOLMES SELLERS. *Proc. R. Soc. M. Lond.* 1947 40 645.

This article is a continuous discussion of nontuberculous empyema by two authorities. Brock considers an empyema as a localized collection of pus in the pleura, and a mature abscess as the end result of an acute suppurative process. The fundamental treatment of the empyema is reduced to 4 points: (a) assessment of the correct time for drainage, (b) provision of adequate drainage, (c) institution of proper physical treatment, and (d) decision as to the correct time to stop drainage.

Perhaps the most important thing we have learned in chest surgery from the war is that great success

can follow early evacuation of the clot and decortication of the lung in an infected hemothorax. A patient gravely ill with a chest full of infected clot which is breaking down, and often with a heavy mixed and foul anaerobic infection either dies or drifts into chronicity if treated by aspiration or by drainage alone. If treated by open thoracotomy and decortication of the lung and if the expansion of the lung is maintained by continuous pleural suction these patients get well can be completely healed in 2 or 3 weeks, and are left with a virtually normal chest. The operation is a severe one but is well tolerated if performed with simultaneous blood transfusion.

Scollors brings out the fact that chemotherapy can achieve good results. It is realized that chemotherapy, particularly penicillin therapy can achieve good results in diffuse and early infection, but its use in a local pleural abscess is open to definite limitation. Penicillin can certainly sterilize many of these abscesses but it cannot obliterate the actual cavity and persistence of the cavity beyond a certain stage increases the liability to formation of a chronic thick walled dead space. Scollors then discusses the method of closure of the empyema cavity after drainage, maintaining that 2 factors will prevent chronic empyema: (1) the maintenance of adequate drainage until the cavity is obliterated and (2) breathing exercises and physical treatment to restore respiratory function and to encourage the lung to re-expand.

STEPHEN A. ZIEGLER, M.D.

HEART AND PERICARDIUM

Studies of Cardiac Disturbances in Cases of Healed Traumatic Chronic Empyema of the Pleura
JAAKKO S. AALTO. *Ann. chir. gyn. fenn.* 1947 36 Supp. 2

The aim of this investigation was to clarify the importance of the cardiac disturbances in the degree of disability following chronic empyema cavities caused by war injuries. An endeavor has been made to find an answer to the following questions:

Is there a disturbed heart function and what is its extent in cases of healed traumatic chronic empyema?

To what degree is the disturbed function of the heart caused by intracardiac, and by extracardiac factors?

Which intracardiac and extracardiac factors are the most important in this respect?

Are the disturbances in the function of the heart severe or slight, and what is their prognostic significance?

In what way is the incidence of these disturbances affected by the duration of the primary disease and by the size and location of the empyema cavity?

The material comprises 58 cases, all males aged 20 to 49 years. Prior to being wounded, none of them showed symptoms of heart disease. As a result of war wounds 19 patients had a total chronic empyema 37 patients had a small or moderate sized

cavity limited to the lower or lower and middle part of the pleura and 2 patients had a small or moderate sized cavity in the upper part of the pleura. The cavity was on the left side in 31 patients and on the right in 27. All patients were treated surgically, the most frequent intervention being an extrapleural or intrapleural thoracoplasty often combined or supplemented by myoplastic operations of varying type and once by decortication of the visceral pleura. The primary disease and its treatment have left more or less extensive deformities in the chest: scoliosis of the vertebral column, pleural adhesions, rigidity and abnormal positions of the diaphragm, displacement of the mediastinum and its organs, pulmonary hernias and paralysis of the upper abdominal muscles.

The follow-up examinations in the different cases took place after periods of 1 month to 4 years had elapsed from the time of healing of the chronic empyema cavity. Two patients were examined 3 times, 25 were examined twice and 31 once. The follow-up examinations of the same patients were generally 6 months apart. Taking all examinations in the different cases into account the number of follow-ups was 41 in the first year after healing, 21 in the second, 15 in the third and 10 in the fourth year.

Besides an ordinary clinical examination the subjects were submitted to the following special tests: the pulse rate, arterial pressure, vital capacity, venous pressure and circulation time were observed during rest and after exercise. Special attention was paid to the electrocardiographic alterations during rest and at given intervals after exercise.

Although after the healing of the primary disease the majority of the patients showed subjective symptoms pointing to cardiac disorders, disturbed function of the heart could not be ascertained in any of the patients by means of ordinary clinical examinations. The pulse rate, arterial pressure, vital capacity, venous pressure, and circulation time determined during rest and after exercise corresponded with that of healthy individuals in at least four fifths of the cases. At the later follow-up examinations a decrease in the number of abnormal results was generally observed. As these results may be directly influenced by many extracardiac factors (and this was true in the present series) greater significance must be attached to the normal findings than to those diverging from the normal when evaluating the function of the heart. In all of the cases several of the 5 functional tests and in more than one third of the cases all 5 tests suggested a normal cardiac function. Definite conclusions cannot thus be drawn as to the presence of disturbed heart function on the basis of these tests. In view of the fact that results may be directly influenced by extracardiac factors, the results should be considered indicative of the general ability of the organism which is conditioned by several factors—in the first place by the state of the nervous system, the respiratory tract and the circulatory system. At successive examinations the

results in the cases studied showed the direction of development of the regenerative phenomena in the pathomorphological and physiopathological changes.

Electrocardiographic abnormalities are not generally caused directly by extracardiac factors, but arise as a result of disturbed cardiac function. For that reason the chief conclusions in the present investigation must be based on changes in the electrocardiogram. In addition the electrocardiogram particularly after exercise often indicates the cause of the functional disorder it does not however reveal the degree of the disturbance as a rule. Ordinary clinical examinations may to some extent support the electrocardiographic studies regarding the causes and degree of the functional disturbances. On the basis of the pulse rate arterial pressure vital capacity venous pressure and circulation time, conclusions may however be drawn only regarding the degree of the disorder.

In 24 of 58 cases electrocardiographic abnormalities indicated the presence of a disturbed function of the heart. In 14 cases the alterations were attributed to intracardiac factors. In 7 cases it was impossible to establish whether the causes were intracardiac or extracardiac and in 3 cases the symptoms suggested extracardiac factors.

The studies justify the assumption that the intracardiac causes of disturbed function of the heart are chiefly infectious infectious-toxic or anoxic changes in the myocardium. The changes caused by the infection arise principally via the blood stream, although a direct infection via the pericardium is also possible. A deficient oxygen supply to the myocardium may be due to anoxemia, possibly caused by pathomorphological and physiopathological changes in the chest and its organs, or to a decrease in the cardiac output which particularly in a part of the myocardium which is overburdened or has undergone myocarditic changes may easily result in anoxic changes. An overload on the right heart due to possible hypertension in the ordinary pulmonary circulation is then chiefly to be considered, as nothing has been noted at the examinations to indicate valvular disease. On the other hand a myocardium with deficient oxygen supply or an overburdened myocardium may be exceptionally susceptible to infective processes. It seems that in the cases in which the disturbed function has been attributed to intracardiac causes, myocarditic lesions, either alone or in association with anoxic myocardial injuries, are perhaps the most frequent. Extracardiac causes of functional heart disorders are especially those factors which cause a deficient oxygen supply to the myocardium and have not been sufficiently strong or long-standing to cause myocardial lesions. An other factor to be considered in particular is the exceptionally great lability of the nervous system in the present series of cases.

Decompensation was not observed in any of the cases. Routine clinical examination did not even reveal distinct symptoms of compensated heart disease. The functional heart tests showed that the

functional disorders were slight the tests also indicated that certain extracardiac causes of disturbed heart function decrease in the course of time. However definite conclusions regarding the prognosis can be drawn only by studying the cases closely over a long period of time.

The duration of the primary disease does not appear to influence the frequency of disturbed cardiac function. It is decidedly higher in cases in which the chronic empyema cavity has been larger than in cases in which the cavity has been small. The incidence of disturbed cardiac function is similarly higher if the cavity has been on the left side rather than on the right.

JOHN J. MALONEY M.D.

ESOPHAGUS AND MEDIASTINUM

The Sclerosing Therapy of Esophageal Varices.
Cecil O. LATTINSON and MILWARD O. ROCH.
Gastroenterology 1947 9: 39

Over a 4 year period 24 patients (26 were seen but 2 refused sclerosing therapy) have been treated for recurrent massive hematemesis by the injection of a sclerosing solution in the esophageal varices at esophagoscopy. The subjects ranged in age from 3 to 66 years.

These 24 patients had a total of 76 esophagoscopies with 209 injected sites receiving a total of 600 c.c. of 5 per cent sodium morrhuate. The average total injection per patient was 25 c.c. approximately 5 c.c. per varix punctured the minimum was $\frac{1}{2}$ c.c. and the maximum 24 c.c.

The incidence of episodes of hemorrhage would appear to have been significantly reduced as a result of the therapy based on a pre-injection incidence of bleeding. Of the 24 patients treated, 9 have died. Of the 9 who died 6 had hematemesis as a part of the terminal picture. The other 3 died of other causes without recurrence of hemorrhage.

Of the 16 patients under 40 years of age who had had splenectomy and were given sclerosing therapy 2 died. Of 8 patients under 25 years of age who survived splenectomy and had sclerosing therapy none died.

Fifteen of the patients treated were considered to have a cirrhotic liver 9 were believed to present Banti's syndrome and 8 of these had had splenectomy. The ninth patient has been advised to submit to splenectomy. Such corrective surgical treatment is considered necessary to the best results from sclerosing therapy. HIRSH T. LANGSTON M.D.

Gastroesophageal Resection and Total Gastrectomy in the Treatment of Bleeding Varicose Veins in Banti's Syndrome. DALLAS B. PIERCE and ELEANOR M. HUMPHREYS. *J. Am. Surg.* 1947 26: 397

Splenectomy portacaval shunt and injection of esophageal varices with sclerosing solutions have been the most reliable methods of controlling esophagogastric bleeding in Banti's syndrome. Splenectomy may fail to control the situation ultimately as

portal hypertension recurs. Portacaval shunt is not possible in certain situations and even when performed the stoma may narrow or close. The injection of sclerosing solutions has not been uniformly successful. Resection of the bleeding segment is another approach to management which even though it may throw an additional load on the remaining collateral routes may be justified because these segments either do not bleed at all or they bleed infrequently.

The detailed reports of 2 cases in which this approach in management was utilized are given. The first case had frequent severe hemorrhages from gastric varices after splenectomy and extensive obliteration of esophageal varices by injections. The liver was considered normal. Total gastrectomy was performed 3½ years ago. Only two attacks of hemorrhage have been experienced since one moderate and one slight in extent.

The second patient is free from bleeding 3½ months following a transthoracic esophagogastric resection performed for severe hemorrhage which had continued after splenectomy.

The study of the surgical specimen emphasizes the importance of gastric varices as a source of bleeding in addition to those present in the esophagus. The reports of these 2 cases are documented by numerous photomicrographs.

HIRSH T. LINGSTON, M.D.

Carcinoma of Esophagus. RICHARD H. SWIFT, J.
Am. J. Am. Surg. 1947 135:485

The author appraises the immediate and late results of resection and primary esophagogastric anastomosis for carcinoma of the esophagus or cardiac end of the stomach at the Massachusetts General Hospital, Boston, since it was first performed in 1939. There were 213 cases in the series and 66.2 per cent of the lesions were considered resectable. These figures include the resectability rate for carcinoma of the midthoracic esophagus as well as of the cardia and lower esophagus. There were 72 patients with midthoracic lesions, 50 of whom were operated upon and 741 patients with lesions of the cardia and lower esophagus, 91 of whom were subjected to resection. Seventy-nine of these latter patients survived the operation, 30 living for periods of from 6 months to 7 years, whereas of the 50 patients with midthoracic lesions who were operated upon, 30 lived for periods of from 6 months to 3 years.

The principal complications encountered after resection were infection, mediastinitis, cardiac, pulmonary and vascular disorders, and these rated high in the causes of death.

Dysphagia is the most distressing symptom of the disease and operation is considered the most effective single procedure in alleviating this pathetic disturbance. This is the opinion of the author and the fact that recurrence at the anastomotic stoma seldom develops thus giving the patient comfort for from 6 months to 2 years, make the operation worthwhile.

STEPHEN A. ZIEGLER, M.D.

Further Observations on Post Tracheotomy Mediastinal Emphysema, and Pneumothorax. GILBERT H. FOSSER, GEORGE SALVOY and JOHN C. HILBERG. *J. Pediatr. St. Louis*, 1947 31:173

The authors report their observations following tracheotomy in 120 children. Sixty-eight per cent of the children were under 2 years of age, 22 per cent were from 2 to 5 years old and 10 per cent were from 5 to 10 years old. They were carefully studied for signs and symptoms of mediastinal emphysema and pneumothorax. Seventy-four of the children were examined roentgenographically.

Twenty-five per cent of all children developed mediastinal emphysema and 10 per cent developed pneumothorax. Since the incidence of these conditions was higher among the patients who were examined roentgenographically it is believed that some cases among the remainder of the patients may have been missed.

The authors compare the incidence of mediastinal emphysema and pneumothorax among patients in whom the bronchoscope (or other airway) was in place at the time of operation with that among patients in whom the bronchoscope was not used. The development of mediastinal emphysema and pneumothorax was greater among the patients in whom the bronchoscope had not been used and indicates the importance of a free airway at the time of tracheotomy to prevent the suction of air into extrathoracic tissues.

Treatment consisted of the prevention of further infiltration of air. In the more serious cases, the air was sucked out with a needle and an oil syringe.

CLINTON H. THURTELL, M.D.

MISCELLANEOUS

An Evaluation of Methods of Penicillin Therapy in Thoracic Surgery. JOHN H. DONNELLY, FRANCIS J. PHILLIPS, J. P. BARTLETT and W. E. ADAMS. *Ann. Surg.* 1947 126:579

Believing that the penicillin titers in body fluids formed a more accurate appraisal of therapeutic effectiveness than mere clinical estimate of improvement the authors undertook the present study with particular reference to thoracic surgery. Penicillin levels in blood serum or pleural fluid after administration of the drug therefore form the basis of such appraisal. The routes of administration investigated were intramuscular, intratracheal, by inhalation of a combination with aerosol, and intrapleural.

The observations were made in human subjects in 85 instances and by 46 experiments on dogs. The observations in human beings and animals were generally well correlated except when the drug was given intrapleurally in which instance it seemed to be absorbed much more rapidly in dogs than in man. Also the inhalation method presented obvious mechanical difficulties in dogs.

The blood serum levels obtained following the administration of penicillin by the various routes is summarized graphically in the accompanying illus-

Penicillin Serum Levels Various routes

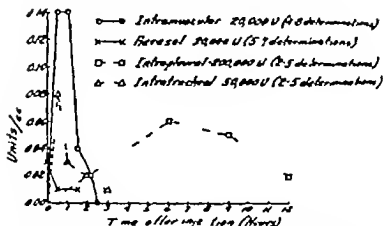


Fig. (Doanally *et al.*) Chart showing penicillin serum levels (units per c.c.) in the time shown following administration by various routes. (Courtesy of J. D. Lilly and Co.)

tration. More detailed data including maximal minimal and average levels for each of the investigations are presented however.

Concerning the levels in pleural fluid, it is seen that by the intramuscular injection of 40,000 unit every 3 hours good therapeutic level can be maintained 30,000 unit however are less effective. With intrapleural administration the pleural fluid level is high initially but it remains at effective levels for 4 or 5 days when 200,000 unit are used.

Intratracheal instillation and aerosol administration will produce short periods of effective blood serum levels, but their practical usefulness seems limited to local therapy for bronchopulmonary infections.

The intramuscular route is the best for providing desirable blood serum titers and will, when administered in 40,000 unit doses, produce therapeutically effective levels in pleural fluids.

H. W. T. LAWSON, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

The Subcutaneous Inguinal Ring: A Clinical Study
JAMISON L. CHERRIN *Surgery* 1947 23 540.

Of 5,956 subcutaneous inguinal rings in a 978 men studied by the author 78 per cent were large enough to admit the index finger without force. This is at variance with the published statements by a number of investigators. Of the 724 men whose subcutaneous rings were not bilaterally equal in size 57.5 per cent were larger on the left side whereas it is generally known that hernias occur more often on the right side. The author believes that there is no convincing proof that a large subcutaneous ring either is in itself abnormal or that it predisposes to the future development of hernias. He believes that it should not disqualify men from industrial employment.

ROBERT TURELL, M.D.

Internal Supravescal Hernia ROY MILLER, *Brit J Surg* 1947 35 84.

The author described a rare type of hernia known as internal supravescal hernia. The supravescal fossa is a triangular area bounded laterally by the obliterated umbilical vessels and below by the reflection of the peritoneum on to the dome of the bladder of peritoneum over the urachus. Below the peritoneal reflection is the potential space between the symphysis pubis and the bladder which is known as the prevesical space or the space of Retzius.

Men are affected more commonly than women in the proportion of 9 to 1. The small bowel is almost always involved, which causes symptoms of high intestinal obstruction. Most cases have usually been discovered at exploratory laparotomy. The treatment is that accorded to intestinal obstruction with strangulation. The hernia is reduced and the sac is obliterated. No recurrence has ever been reported following simple closure of the neck of the sac with interrupted or continuous sutures. In 37 authentic cases there has been a mortality rate of 40.5 per cent. When resection of the bowel is necessary the mortality is increased. In the author's case recovery followed reduction of the hernia and closure of the neck of the sac.

ROBERT TURELL, M.D.

GASTROINTESTINAL TRACT

Hematemesis and Melena. F AVERY JONES *Brit M J*, 1947 3 477

The change in the form of therapy in cases of hematemesis from a very restricted fluid intake and small transfusions to early feeding and frequent transfusions has been accompanied by a significant and marked drop in mortality. Liberal drip transfusions and early feeding actually reduce the risk of

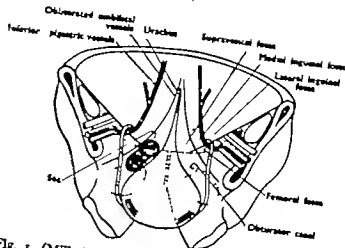


Fig. 1 (Miller) Drawing showing the position of the hernia.

further bleeding and lower the mortality of recurrent hemorrhage. These statements are supported by statistical data. Autopsy reports of fatal cases treated by the older method show that in 18 of 39 cases the hemorrhage had ceased at the time of death and that many of the patients had not bled for some days previously. The authors believe that these deaths were due to uremia which was the result of the extreme dehydration brought on by the form of therapy.

Errors in diagnosis may arise disorientation from cerebral anoxia may be the presenting symptom and the melena may not be discovered until the patient is in the hospital. Dyspnea, edema and distended jugular veins may lead to an erroneous diagnosis of congestive failure. Cardiac pain from recent acute history of red blood in the stools may lead to the admission of the patient for hemorrhoids. Dark red fluid stools have often been observed after a brisk 'tarry' character may be misleading. Observations following the oral administration of citrated blood in man have shown that from 100 to 150 ml. of blood are necessary to produce a tarry stool while the administration of 2,000 ml. of blood by means of a Rehfuess tube into the upper gastrointestinal tract in a 4 hour period frequently resulted in stools extremely bloody but never tarry presumably from intestinal hypermotility. The appearance of the patient soon after the hemorrhage is extraordinarily misleading. The profound circulatory collapse and great clinical improvement. The initial pallor is probably due to the intense vasoconstriction which may occur as a response to hemorrhage. Fever after gastroduodenal hemorrhage is common and may persist for some days. The fever is not due to the presence of blood in the intestine but is possibly

related to the endogenous breakdown of body protein. The persistence of pain after a hemorrhage is well known to be uncommon, but the mechanism of this relief is unknown. Pain persisting after a hemorrhage is a bad prognostic sign and severe persistent pain has been noted only in fatal cases. Coronary thrombosis may be precipitated by the hemorrhage. Anemia is a well recognized and tragic complication of gastroduodenal hemorrhage; the vasoconstriction following bleeding may so severely reduce the blood supply to the optic nerve that irreversible damage from anoxia ensues.

It is well recognized that many of the patients with hematemesis and melena fail to show any evidence of peptic ulcer when a barium meal is given during convalescence. To investigate the cause of the bleeding in this group early gastroscopy was performed usually between the third and tenth day. In 60 per cent of these cases superficial acute ulcers were found to be the source of the bleeding, and because of their size and rapid healing they would not be visualized by barium meal later in the convalescence. Atrophic and hypertrophic gastritis is more rarely the cause of the hemorrhage. Patients bleeding from an acute ulcer had a much better prognosis than those bleeding from a chronic ulcer. Because of the much better prognosis of acute ulcers it is necessary to distinguish them if possible at the bedside, especially when the question of surgical intervention arises. Bleeding may be very severe from such ulcers and recurrence of the bleeding after admission is not uncommon. The pain of acute ulcers if present is never severe and has seldom lasted more than a week, while the absence of pain in these cases is a common history.

While heavy sedation should be avoided in the treatment, early reassurance and lessening of anxiety is important. A decision should be made early as to whether operation is to be considered if the patient bleeds again. An hourly pulse and blood pressure chart is kept and blood typing performed. The patient is allowed a semisolid porridge diet with 2 hourly feedings or 300 ml. of milk if preferred. Antacids are not essential but may be given. In severely ill patients with a long history a continuous milk drip may be of value at least during the night. If the vomiting reflex is diminished and the stomach distended with blood aspiration of the stomach is indicated. Oxygen therapy and the administration of vitamins B and C may be helpful. There was an 8 per cent mortality in the current series.

F J LEBERMAN, JR., M.D.

The Effect of Vagotomy on Human Gastric Function. ARTHUR M. SCHORN and R. ARNOLD GREEN. *Ann Surg* 1947 130: 655.

The authors summarize current opinion as to the etiology of ulcer and suggest that it may be secondary to (1) alterations of psychogenic or neurogenic origin, (2) alterations of the function of cells of internal or external secretion, (3) local alterations of the mucosal anatomy or physiology of the af-

fected mucosa, or (4) a reduction of the constituents of gastric contents produced by other organs such as the liver, pancreas, salivary glands, and the duodenum. It is likewise believed that the mechanism for the production and maintenance of peptic ulcer is the proteolytic activity of the gastric contents versus the mucosal resistance to devitalization and ulceration.

The purpose of this article is to point out a few of the common fallacies known to be present in the method used in determining gastric secretion by continuous gastric suction, and to describe briefly a new and more satisfactory method of measuring the function of the human stomach.

The method employed in this study of 30 patients consists of injecting into the empty stomach an isotonic solution containing a known amount and concentration of indicator (phenol red) and, after a 15 minute rest period, aspirating the entire gastric residual contents. From the values of quantity and concentration of indicator injected and aspirated, can be calculated the average rates of gastric secretion and emptying during the test period.

By means of this test it is shown that the gastric secretory response to histamine, a humoral secretagogue, is not prevented by complete vagotomy. Therefore a vagotomized stomach is still capable of producing active digestive juice. Complete vagotomy reduces gastric secretion and emptying by abolishing the cephalic phase of gastric function. Peptic activity, however, is least reduced.

In 6 patients, the basal gastric secretory rate was reduced by an average of 36 per cent following vagus resection. The authors conclude that the insulin test (hypoglycemia acts as a potent medullary stimulus to vagus function) for complete vagus nerve section appears to be satisfactory when carefully employed.

EDWARD F. LEWISON, M.D.

Gastric Neurectomy for Gastric and Duodenal Ulceration. WALTER WALTERS, HAROLD A. NELSON, WILLIAM F. BRADLEY, JOHN T. SALL, and JAMES W. WILSON. *Ann Surg* 1947 126: 1.

A study of the anatomy of the gastric nerves has demonstrated that in 92 per cent of the cases the nerves pass through the diaphragm as two distinct trunks and are readily accessible for resection.

The abdominal approach to the gastric nerves allows exploration of the abdominal contents, and especially the ulcer, if it is a gastric ulcer and is suspected of being malignant, it is removed and if the duodenal ulcer is obstructive or likely to become obstructive from gastric atony a drainage operation of the stomach is performed.

In the authors' series of 33 cases, it is important to remember that the disturbances of gastrointestinal motility were for the most part, temporary, although spasm of the pylorus with dilatation of the stomach and hypermotility of the intestine has persisted for several weeks in one patient operated upon for gastric ulcer. In one case gastric ulceration definitely recurred.

In the entire series of 66 cases, perforation of a duodenal ulcer and a subdiaphragmatic abscess caused the death of the patient 14 days after gastric resection and gastroenterostomy and 2 other deaths occurred 1 from a suspected cerebral embolism on the fourth postoperative day and the other at home from a heart lesion. This patient had been subjected to closure of a gastrojejunocolic fistula and gastric resection 3 months previously. In other cases the immediate results, as evidenced by reduction in gastric acidity, gastric secretion, relief of gastropasm and relief of pain were good but not striking. If the good results persist the operation offers an easy and a comparatively safe method of treating certain peptic ulcers, especially recurrent ulcers. It will have a limited application in cases of obstructing duodenal ulcer and in certain cases of gastric ulcer. In the former it can be used in a few cases in association with gastroenterostomy. In cases of gastric ulcer, excision of the ulcer should be done to exclude malignancy. When excision of the ulcer and gastric resection have been done simultaneously disturbances in gastric motility with retention and higher secretion have been troublesome. In any case however sufficient time must be allowed to pass to determine whether the good results are temporary as they seem to be in experimental animals and whether untoward results may develop.

Subtotal Gastrectomy for Gastric Ulcer HENRI K. RANSOM. *Ann. Surg.*, 1947 126 633

The author stresses the differences which exist between gastric ulcer and duodenal ulcer and summarizes briefly the characteristics of gastric ulcer. The present study represents the author's attempt to (1) ascertain the risk involved in operation for gastric ulcer and, to some degree, to determine the incidence of malignant growth; (2) make a critical analysis of clinical end results as far as the gastric ulcer problem is concerned and (3) discover the incidence and severity of certain side-effects of gastric resection such as postresection symptoms, nutritional disturbances and blood disorders.

The clinical material consisted of 1,356 patients treated for gastric ulcer during the 20 year period from 1925 to 1945 at the University Hospital, Ann Arbor, Michigan. Of this number 246 patients (18 per cent) required surgical intervention. End results of gastric resection for gastric ulcer support the view that this is the best means now at our disposal for the treatment of those ulcers which require surgery. The advent of vagal resection is mentioned primarily as an adjunct to gastric resection in an attempt to prevent jejunal ulcer.

The conventional subtotal gastric resection gave the best results regardless of whether a Polya or Hofmeister reconstruction was subsequently done. Three total gastrectomies were performed but the results were unsatisfactory.

In general the follow up end results were found to be satisfactory in 92 per cent of the cases and this compares favorably with any other major surgical

procedure. The operative mortality was 7.9 per cent, pneumonia and peritonitis being the leading causes of death.

The author stresses the fact that the proper therapy in gastric ulcer is still predicated upon one's ability to differentiate a benign from a malignant ulcer. In this series, microscopic study revealed malignancy in 10 per cent of gastric ulcers which even at the time of operation, were unrecognized as neoplastic. This error has been reported as even much higher at other clinics. Therefore as suggested by Graham and Lahey it seems just that patients who are suffering from what may seem to be a benign gastric ulcer be urged to accept partial gastrectomy early in the course of the disease. The operation in capable hands can be carried out without a prohibitive mortality and the number of carcinomas discovered will make the risk worth while.

EDWARD F. LEWISON, M.D.

Carcinoma of the Stomach DAVID STATT, GEORGE BLOOM, and OWEN H. WANGENSTEIN. *J. Am. Med. Ass.*, 1947 135 262

Gastric resection remains the only mode of treatment that is capable of curing gastric carcinoma.

Cancer ranks second only to cardiovascular disease as the commonest cause of death in this country. One-fourth to one-third of all deaths from carcinoma are due to gastric cancer. As the age of the population increases the number of persons who die from gastric carcinoma will also grow larger and it has been estimated that by 1960 as many as 40,000 patients will succumb to gastric carcinoma annually.

An exhaustive review of the world literature on the end results of the treatment of gastric carcinoma up to 1937 was compiled by Livingston and Pack. More recently Maimon and Palmer in addition to summarizing and analyzing their results at the University of Chicago brought the literature up to date. These authors called attention to wide variations in the published data from various institutions and emphasized the need of analyzing all published statistics with respect to four factors: the total number of patients with gastric cancer, the number of patients subjected to operation, the number of patients in which a gastric resection was done and the number of survivors in relation to the total.

The total number of patients with gastric carcinoma seen at the University of Minnesota Hospitals over a period of 10 years was 586. Of these 432 were men and 154 were women. The average age was 63.2 years. Nineteen patients were in terminal stages of the disease when first seen but their cases were included in the statistical data.

The number of patients operated on was 447, an operability rate of 76.3 per cent.

Three hundred and seven patients underwent gastric resection, a resectability rate of 52.2 per cent. In this group there were 31 total gastric resections and 276 partial resections.

The operative mortality among the 307 patients subjected to gastric resection was 16.6 per cent.

Among the 276 partial gastric resections, the operative mortality was 15.2 per cent and among 31 total gastric resections the operative mortality was 30 per cent.

Eighty five exploratory laparotomies were performed with a mortality rate of 8.5 per cent, 25 gastrojejunostomies with a mortality rate of 24 per cent, and 30 enterostomies with a mortality rate of 13.4 per cent.

There were 51 deaths following gastric resection and in 44 of these it was possible to obtain autopsies. The major cause of death was peritonitis which accounted for 28 fatalities. 8 patients succumbed to pulmonary complications. 4 died of cardiac failure, 3 of renal complications. 2 of pulmonary embolism, 1 patient died of cerebrovascular accident, and 1 of shock. In 4 cases the cause of death was undetermined.

Because sufficient time has not elapsed the percentage of patients surviving for periods of 3 and 5 years can only be determined in relation to those patients who were operated on in the periods from 1936 to 1943 and from 1936 to 1941. The percentage of patients surviving 5 years after gastrectomy was 10.7 per cent, but based on the number of patients subjected to gastric resection it was 20.4 per cent. The percentage of patients surviving 5 years was 6.6 per cent, but determined on the basis of the number of patients surviving gastric resection it was 21.5 per cent.

Gastric resection was the only palliative procedure of value. The average number of months of palliation following gastric resection was approximately 22. In the main the patients were comfortable up to the last few weeks before their death.

The operability and resectability during the 10 years of study have increased markedly. In 1936 the operability and resectability rates were 37 per cent and 28 per cent whereas in 1945 these rates were, respectively 88 and 80 per cent. The resectability rate for 1945 based on the number of patients explored was 80.7 per cent. The mortality rate for partial gastric resection in 1936 was 15 per cent, while in 1945 it was 4.9 per cent, which figure includes both total and subtotal gastrectomy.

HARRY W. FINE, M.D.

Report of Prolonged Follow Up Study of 2 Patients who Underwent Partial Gastrectomy When Young. PAUL MCGUFFY and CARL G. MORLOCK. *Gastroenterology* 947 9: 307

The need for a major surgical procedure of any type on the stomach of a child is infrequent. Rarely indeed is it found needful to sacrifice the greater portion of a child's stomach. Because of this and the attention that has been drawn to the nutritional disturbances which sometimes follow partial gastrectomy the authors deemed it worth while to report the cases of 2 patients who underwent partial gastrectomy when young and were followed up for a total of 21 and 30 years respectively. Normal physical development and excellent health have been the

experience of one patient. Half of this patient's stomach had been removed when she was 10 years old. In the second case, approximately a fourth of the stomach was removed. The patient was 16 years of age. Postoperatively she developed normally and remained well for 30 years, except for some difficulty in maintaining her weight.

Peptic Ulcer: A Diagnostic and Therapeutic Problem. SARA M. JORDAN. *Gastroenterology* 947 9: 317

Among the large group of diseases influenced by psychic factors there is probably none in which the psyche plays any greater part than in peptic ulcer. Therapeutic measures are deficient if they fail to include adequate protection of the mental and nervous state of the patient. In any consideration of physical conditions with psychosomatic aspects, however it must always be remembered that the somatic factor is a real one, and that there may even be a somatopsychic as well as a psychosomatic interplay.

Opinion is now rather general that peptic ulcer is associated in origin with a combination of three factors: increased muscular contraction which is commonly termed spasm, increased secretion of hydrochloric acid, and decreased resistance of the mucosa to these two abnormal factors. The basic etiology behind these factors remains unidentified. There is an etiologic influence from the mind and nervous system upon the genesis of ulcer. It is likewise certain that other influences also play an etiologic role—such as infections elsewhere in the body e.g. respiratory infections, the toxic effects of alcohol and smoking, habitual irritation from food which is difficult of digestion. And behind all these influences there must, of course, be a predisposing factor which causes certain individuals to be gastrically and intestinally sensitized to these influences, while others are entirely resistant. Whether that basic predisposition is dependent upon localized diminished resistance or upon a hormonal defect, or upon some other as yet unconceived factor remains an unsolved problem.

Once a diagnosis of peptic ulcer is accurately made it carries with it certain very definite therapeutic involvements some of which may be permanent throughout the life of the patient. It is of prime importance to the patient that a timely diagnosis be made so that a decision concerning later habit restrictions or lack of restrictions is logically made. Clinical experience tends to show that peptic ulcer is too infrequently diagnosed rather than too frequently diagnosed. The typical ulcer history is well defined, its main points being periodicity and time relationship to meals, coupled with relief by food, even cold food, and by alkalis. A history of ulcer may however become completely atypical when other disease organic or functional, such as a cholecystic lesion or an irritable colon, masks the clinical picture. In this respect one must always analyze carefully the history of a suspected ulcer recurrence, inasmuch as certain of the therapeutic measures for ulcer especially magnesium and the silicates, may

produce a small intestinal and colonic irritability the symptoms of which may be confused with those of recurrent ulcer. Extreme care in eliciting and evaluating the history is essential in these cases since important determinations for or against radical treatment are often made on the basis of relief or failure of relief of symptoms and symptoms cannot be effectively relieved unless adequately diagnosed.

The diagnosis of peptic ulcer is never aided by physical examination of the patient except when confirmatory evidence is supplied by the finding of localized tenderness. Chemical findings particularly free hydrochloric acid and occult blood in stools are significant diagnostic data. An active duodenal or jejunal ulcer is rarely seen without high acid findings, and the course of healing of duodenal ulcer may often be gauged by the change in acid values. It is unnecessary to use fractional analysis in most cases—an Ewald meal and aspiration 45 minutes later gives adequate data. In gastric ulcer only the presence or absence of free acid is important, since an active gastric ulcer is less commonly attended by hyperchlorhydria than is the duodenal lesion. In untreated cases achlorhydria should be regarded as a finding suggestive of malignancy however the corollary of this statement, namely that gastric carcinoma is always attended by achlorhydria, is not dependable since probably 40 per cent of patients with gastric carcinoma have free acid. The finding of occult blood in the stools is important only when conditions of food intake and gum bleeding are very carefully controlled. Under these circumstances of course persistent occult blood means unhealed ulceration and if this continues under treatment of a gastric ulcer malignancy must be suspected.

X-ray and endoscopy particularly when the latter supplements the former, are our best aids in the diagnosis of esophageal and gastric ulcer and x-ray alone in the diagnosis of duodenal and jejunal ulcers. In about 30 per cent of cases it is impossible to make an accurate diagnosis of peptic ulcer without the use of fluoroscopic as well as film examination. In all cases fluoroscopy supplements film examination to such an important degree that it should never be omitted. This is especially true when there is a question of supplanting medical with surgical treatment or when a patient with ulcer is under treatment and the course of healing or the question of recurrent activity is being determined. Irritability in the still active or recurrent duodenal or jejunal ulcer is indicated by rapid filling and emptying of the bulb or by marked spasm in the duodenal bulb or at the stomach. One of the most valuable procedures developed during the last 10 years of radiographic work with peptic ulcer is the visualization of the rugal pattern of stomach, duodenum, and jejunum. The grossly deforming ulcer of the duodenal bulb is obvious both in the fluoroscopic and film examination. However a differentiation must often be made between the active and quiescent ulcer and fluoroscopy is then the best diagnostic aid since it reveals rapid filling and emptying and spasm so characteristic of the ac-

tive phase of ulcer. One of the fundamentals of good gastroenterology is complete familiarity with fluoroscopy and film reading. The knowledge of the physiology and of the pathologic abnormalities and aberrations of the digestive tract obtained by skill in this field is a priceless acquisition for the gastroenterologist.

The therapeutic measures have in large measure been directed toward the neutralization of gastric acidity and the alleviation of spasm. The problem of gastric ulcer is a different matter. Here we are dealing with a lesion of which we know that it is some times a wolf in sheep's clothing—that it may look like a benign ulcer and yet harbor malignant changes within itself which sooner or later will convert it into an invading carcinoma. The question arises can gastroenterologists take the responsibility of differentiating between the lesion which is potentially innocent and that which is or will be malignant? If they use adequate caution they can. The unhealed ulcer and the recurrent ulcer when located on the gastric side of the pylorus are the threat to safety in other words it is the question of chronic irritation in a terrain highly susceptible to malignant changes. Two principles should be observed meticulously the first that the gastric ulcer however benign it may appear should be closely watched to the point of absolutely complete healing a process which should occur within 3 to 5 weeks at the most. The criteria for healing are the same as have been used in the past—that symptoms, occult blood, and x-ray defect shall completely disappear with trial management, but many cases are checked gastroscopically as well as by x-ray for complete healing. All recurrent gastric ulcers, however benign they may appear to be must have gastric resection. If these two principles are carefully observed gastric carcinoma in an ulcer will not be missed.

A survey of gastric ulcers is being carried out it is still incomplete but figures thus far indicate an incidence of about 10 per cent malignancy in lesions which looked like ulcer and of about 5 per cent in cases in which continued medical treatment was too long. The differentiation of duodenal ulcers as to whether they should be treated medically or surgically is chiefly a matter of tractability. The duodenal ulcer with complications is also often a surgical problem. Here, however two observations based on experience should be made (1) the obstructed ulcer is often not truly obstructed (2) the ulcer with a history of multiple hemorrhages may prove to be as unsatisfactory after surgical as after medical treatment. With regard to obstruction in many instances apparent obstruction is due not to cicatricial narrowing which requires surgical intervention, but to edema and inflammation from an acute ulcer which is relieved by a few days medical management and will not recur if the ulcer heals and remains healed. The adequacy of previous medical treatment should be given careful consideration before surgical intervention is advised. A few days of hospital rest under an ulcer management based on the Sippy regime though

often modified to the individual requirements, results in clinical relief of all symptoms and in x-ray evidence of healing, unless the ulcer is intractable. In cases in which night pain has been a feature, this is relieved in a few days by nocturnal hourly administration of a neutralizing medication, if it is to be controlled at all by medical management. Tractability is, therefore, easily determined clinically as well as by x-ray within a very reasonable time a week at the longest. This fact, in addition to the very compelling reason that rest, neutralization and education can best be accomplished with the patient in the hospital under constant observation makes hospitalization most advantageous.

Enterogastrone and vagus resection are fledglings whose development merits careful observation with the hope that either one may provide a short cut in ulcer therapy if an ulcer is detected early enough and often even when it is diagnosed late if it is treated intensively by the routine method of rest and neutralization good results can be expected and with thorough education of the patient as to the nature of the disease and with his co-operation or control, permanent freedom from recurrence may be expected.

CHARLES BARON, M.D.

Gastric Neurotomy: Anatomic and Physiologic Studies with Favorable and Unfavorable Results in the Treatment of Peptic Ulcer WALT MAM WALTER, HAROLD A. NEUBERG, WILLIAM F. BRADLEY, JOHN T. SMALL, and JAMES W. WILSON. *Arch. Surg.* 1947 55: 5

Reports of other surgeons led the authors to study the problem of resection of the vagus nerves, or as they prefer to call the operation, gastric neurotomy, from the anatomic, physiologic, and chemical standpoint in 40 patients operated on at the Mayo Clinic up to January 15, 1947.

Only brief reference will be made to additional cases in which operation was performed by other surgeons at the clinic, for they will individually report on their results in detail later.

Anatomic dissections of the gastric nerves made on 56 men, 44 women, and 11 children during the course of postmortem examinations indicated that the gastric nerves could be located and successfully resected near the diaphragm by either a transabdominal or a transthoracic approach in approximately 93 per cent of the cases, and that possibly most, if not all, of the branches in the remaining 8 per cent also could be located in the same way.

Results of gastric neurotomy are inconstant, variable and, in most cases, unpredictable. The relief of pain obtained may be the result of the release of gastroparesis and a reduction in gastric acidity as a result of the interruption of cephalic stimulation. The expense of this relief of pain is dilatation of the stomach with frequent troublesome retention of gastric secretion and, in some cases, food remnants. Moreover that relief of pain is not the result of healing of the ulcer must be considered since in one case acute perforation of duodenal ulcer developed.

In one case a gastric ulcer recurred in other cases failure of the ulcers to heal has been demonstrated pathologically at subsequent operations necessitated by a continuation of bleeding or a marked degree of gastric retention which interfered with the patient's nutritional state.

Reduction in gastric acidity although it has occurred in most cases, is inconstant in others and the disturbances of motility of the stomach and small intestine are frequent after operation. In some cases these disturbances are temporary and in others prolonged, persistent, and troublesome to the patient. In such cases patients have complained of frequent belching of foul smelling gas, fullness and bloating after meals and a few patients have complained of nausea and diarrhea. Subsequent operations have been necessary in some cases to remove the persistent ulcer or to provide drainage.

There have been three hospital deaths in these 83 cases. Although 3 of these could be directly attributed to cardiovascular accidents, 1 patient died of unsuspected perforated duodenal ulcer with a subdiaphragmatic abscess. Gastroenterostomy had been done at the time of the gastric neurotomy. Another patient died from a coronary occlusion at home, 3 months after the closure of a gastrojejunal colic fistula.

In evaluation of the results of the operation, it must be proved that an ulcer is present and that the gastric nerves have been completely sectioned. It is the opinion of the authors that the best approach in most cases in which gastric neurotomy is contemplated is by means of a transabdominal incision for this approach permits exploration of the gastro-intestinal tract and such procedures as are necessary to supplement the gastric neurotomy. The greatest field of usefulness for the operation seems to be in the treatment of ulcers after partial gastrectomy and in certain cases of nonobstructive duodenal ulcers in which the cephalic phase of gastric secretion is marked and pain is intractable.

In view of the inherent ability of the gastro-intestinal tracts of human beings, like that of animals, to regain through compensatory mechanisms their function after operative procedures which disturb the neuromuscular continuity and in view of the fact that restoration of gastric acidity and gastric motility has occurred within a year in dogs in which gastric neurotomy has been performed, the possibility of such a return in human beings must be kept in mind.

For the time being the operation of gastric neurotomy will have to be considered as in the investigative stage.

The Management of Patients with Massive Hemorrhage from Peptic Ulcer SERRAUX J. GAY. *Med. Clin. N. America*, 1947 3

Every patient admitted to the hospital with a massive hemorrhage from the upper gastrointestinal tract must be considered a potential fatality. The management of this condition is a challenge, and

sound clinical judgment and the constant observation and re-evaluation of the status of the patient are essential.

Definite establishment of a diagnosis is imperative when a patient is admitted with hematemesis or tarry stools associated with dizziness, weakness, tachycardia and perspiration.

Peptic ulcer causes 75 per cent of all massive hemorrhages. A history of previous ulcer or ulcer distress, previous attacks of hematemesis or melena, or positive x ray evidence of a crater or deformity indicates ulcer as the possible source.

Hypertrophic or erosive hemorrhagic gastritis, esophageal varices, cancer of the stomach, gastric polyps, diaphragmatic hernia, or blood dyscrasias are other sources of hemorrhage.

When the diagnosis is still uncertain after the workup is complete, roentgen examination may be undertaken from 24 to 48 hours after severe hemorrhage or earlier provided the patient is not in shock.

The state of shock, hemorrhage and dehydration must be evaluated and treated. The blood type, including the Rh factor and cross matching should be determined first. Repeated hemoglobin, red blood count, and hematocrit determinations are necessary. A low blood prothrombin time is not infrequently seen in patients with massive hemorrhage from an ulcer. Vitamin K is helpful in these cases. All stools and vomitus should be examined for gross and occult blood as an aid in evaluating the extent and course of the hemorrhage. Plasma proteins, blood urea nitrogen, blood chloride, and carbon dioxide content of the blood must be followed up carefully.

Massive transfusions if given slowly do not cause an appreciable rise in blood pressure and do not produce further hemorrhage. Blood transfusions combat shock, exsanguination and hypoproteinemia and tend to exert a beneficial effect upon the patient's welfare. The contraindication of post-transfusion reaction has been eliminated almost entirely by typing, cross matching and determining the Rh factor in each case.

During the first 48 to 72 hours, parenteral fluids are necessary to maintain the circulating blood volume, re-establish the normal electrolyte balance, and combat dehydration and azotemia. Enough fluids should be given (electrolyte requirements as indicated by the blood chemistry) to maintain an adequate daily renal output. Excessive amounts of fluids and too rapid administration should be avoided. The total daily intake should approximate from 2,000 to 2,500 c.c.

The starvation treatment of bleeding ulcers is outdated as the empty stomach neither prevents the secretion of acid nor decreases gastric motility. Small hourly feedings should be given if they are tolerated by the patient. This maintains the nutritional state, arrests hemorrhage by reducing the gastric acidity and decreasing the gastric motility and speeds blood regeneration. Patients treated this way have a lower mortality than those treated with the starvation regimen. Hourly feedings of 100 c.c.

of milk and cream should be given from 7 in the morning to 10 at night and feedings continued at 3 hour intervals through the night. This routine is continued till the stools are negative for occult blood for 3 days. The usual ulcer regimen with supplementary small feedings is gradually changed to a 3 meal management within 2 weeks. Intubation should be avoided in patients with massive hemorrhage.

High acid gastric juice may favor the extension of the ulcer and may digest the fibrin clot which forms at the bleeding point. As complete and constant neutralization of acid secretion throughout the day and night is desired, further neutralization than can be achieved with milk and cream may be necessary. Calcium carbonate, tribasic calcium phosphate, tribasic magnesium phosphate and aluminum hydroxide are recommended. The addition of from 5 to 10 c.c. of colloidal aluminum hydroxide to the hourly milk and cream is adequate antacid therapy.

Reassurance, good nursing care and sedatives contribute appreciably to the success of the treatment. The patients should be kept in bed until all evidence of bleeding has disappeared and the hematocrit and hemoglobin are within normal ranges.

Antispasmodics such as atropine, in a dose of 0.6 mgm. 4 times a day reduce motor and secretory activity of the stomach.

Secondary deficiencies of vitamins C and K may be avoided by the use of parenteral or oral supplements.

The treatment of choice in acute massive hemorrhage from peptic ulcer is medical but the possibility of a fatal hemorrhage particularly in patients over 50, should always be considered. Surgical intervention should be carried out when necessary within from 24 to 48 hours as the mortality increases rapidly after this period. The surgical service should see all these patients in order that delays may be avoided if surgical intervention becomes necessary. Subtotal gastrectomy is the treatment of choice as simple ligation of the bleeding points is unsatisfactory and leads to secondary hemorrhage. Each case must be judged individually. A hemorrhage is more likely to be fatal in a patient over 50. Fatal hemorrhages are less likely in women than in men. Chances of recovery are better after multiple hemorrhages than after the initial hemorrhage. Certain medical contraindications to emergency surgery may be present. Approximately 70 per cent of the patients with 2 or more hemorrhages are likely to suffer from further hemorrhage. If there are no contraindications, elective surgery should be contemplated for this group. Careful gastroscopic examination to determine the presence or absence of gastritis should be carried out prior to any surgery.

The management of older patients with massive hemorrhage from peptic ulcer presents a difficult problem. Short summaries of the cases of 6 patients between 65 and 70 years of age are given.

All patients who have experienced a massive hemorrhage from peptic ulcer should be observed and studied periodically after their recovery.

ROBERT R. BIGELOW, M.D.

Vagus Resection for Ulcer: An Interim Evaluation
FRANCIS D. MOORE. *Ann. Surg.* 1947 126 664

In a previous article the author describes the operative technique, postoperative management, and hospital morbidity and mortality of vagus resection for ulcer at the Massachusetts General Hospital, in Boston. In his present contribution he reports the clinical results obtained in these patients 2 to 30 months after operation.

It is pointed out by the author that vagus resection for ulcer is at the crossroads, that it is well known as an effective weapon in dealing with ulcer and that the approximate magnitude of the operative side-effects is also known as well as the degree of its failures. The accumulation of factual information must now be utilized to balance the significant advantages against the shortcomings so as to arrive at an evaluation of lasting significance.

The results following vagus resection for ulcer in 74 patients (both private and charity) at the Massachusetts General Hospital are analyzed and a satisfactory end result was reported in 90 per cent of the cases.

Among the side-effects following vagus resection diarrhea was present in 62 per cent of the cases, but it was minor or transient in all but a few cases. Emptying disorders were less common and less important than diarrhea and were taken as a matter of course in most cases. Severe wound pain was uncommon despite the fact that the patients in this series of cases were operated upon by the thoracic route.

Good results were obtained in patients who were intractable to all other forms of therapy, including subtotal gastrectomy. The author believes that vagus resection is an addition to the surgical armamentarium and that it may come to occupy a permanent and important place, although a reserved attitude must be maintained until the present groups of patients have been followed longer.

EDWARD F. LEWISON, M.D.

Resection and Primary Anastomosis in the Treatment of Gangrenous or Nonreducible Intussusceptions in Children CLARENCE DIERKS.
Ann. Surg. 1947 6 788.

During the period between November 1, 1940 and March 1, 1947 the authors performed 8 resections for intussusception at the University of Minnesota Hospital, Minneapolis. Exteriorization and delayed closure was done in 1 case and primary aseptic anastomosis in 7 cases. All patients recovered. The indications for resection were infarction of intussusception in 5 cases; recurrent intussusception with polypoid Peyer's patch in 1 case; developing recurrence while being observed for viability, and Meckel's diverticulum in 1 case; irreducible intussusception due to a large polyp in 1 case.

The choice of procedure lies between exteriorization and early closure on the one hand and resection and primary closure of anastomosis on the other. With a background of closed anastomoses, the latter

course is preferred here. A simple and safe type of one layer closed anastomosis with silk sutures was presented.

CHARLES BARNOW, M.D.

Duodenal Regurgitation. ARTHUR R. MITZ. *Arch. Surg.* 1947 55 239.

The author considers duodenal regurgitation as a clinical entity that has not received proper emphasis by clinicians in previous years.

Its most common cause is pressure on the duodenum by the mesenteric attachment where this part of the intestine passes over the spine. Obstruction may also result from lack of proper rotation of the intestinal tract, tumor or adhesions. It is usually associated with ptosis of the abdominal viscera.

Symptoms vary with the degree of obstruction. When slight there are recurring attacks of nausea, with disturbed appetite and weight loss. As the obstruction becomes more marked the attacks of nausea increase and are followed by a sense of fullness in the right upper area of the abdomen and by vomiting; these commence after the patient begins eating. In the progressive case the anorexia and pernicious vomiting result in extreme dehydration, emaciation, gradual exhaustion and death.

This condition should be suspected from a history of repeated nausea and vomiting not explained by ordinary causes. A positive diagnosis is made by fluoroscopic examination of the stomach and duodenum. The stomach is large and J-shaped with a highly placed outlet. The duodenum is dilated to several times its normal size. A barium meal will be observed to stop at the right of the spine, churn back and forth because of hyperperistalsis and then regurgitate back into the stomach. After a delay of several minutes the barium may be forced over the spine to move along its usual course.

Treatment depends on the severity of obstruction. When slight, medical management should be instituted: regulation of food intake, rest at mealtimes, and various positions of the body postprandially. Further treatment consists of bed rest and frequent small feedings. If the patient does not make satisfactory progress with this type of therapy surgical intervention is indicated.

The accepted surgical procedure is duodenojejunostomy which gives complete relief. Care must be taken to make a large stoma to permit prompt emptying of the distended duodenum. Another operation used is a posterior gastroenterostomy with pyloric occlusion.

The author mentions the cases of 15 patients, 10 relieved by gastroenterostomy and 5 by duodenojejunostomy.

C. FREDERICK KITTLE, M.D.

Some Physiologic Aspects of the Surgical Treatment of Duodenal Ulcer JAMES T. FAHRELEY.
Surg. Clin. N. America, 1947 27 905.

It is generally agreed that medical treatment should be instituted in all cases of duodenal ulcer except those in which certain complications are present. Experience at the Mayo Clinic indicates

that approximately 85 per cent of all patients with this condition can be treated medically. Complications which are considered to indicate the desirability of surgical treatment, and which will be discussed only briefly may be listed as primary or secondary obstruction, perforation, failure of hemorrhage ob-
 ment and any doubt as to the benignity of the lesion.

At present it is the practice at the clinic to institute medical treatment in all cases in which massive bleeding from duodenal ulcer occurs. If after medical treatment has been continued for 48 hours there is still evidence of continued or recurrent bleeding immediate surgical intervention is desirable.

For the patient who has had several episodes of bleeding one is always a little more inclined to suggest surgical treatment. This is especially true if bleeding occurs under ordinary circumstances when the patient has been taking at least fairly good care of himself. Medical treatment which failed to prevent hemorrhages in the past hardly can be considered adequate to prevent hemorrhage in the future.

Obstructive lesions caused by duodenal ulcer may be either inflammatory or sclerotic in nature. The inflammatory type of obstructive lesion usually is seen during a subacute exacerbation of symptoms. Under proper medical treatment, symptoms of obstruction generally disappear in a week or 10 days. It is doubtful however whether more than one or two such episodes should be treated medically because they are likely to recur and cause sclerotic narrowing of the duodenum. When a definite cicatricial type of obstructive lesion results there is little to offer but surgical treatment.

Perforation by a duodenal ulcer may be either a subacute or an acute process. All agree that acute perforation of a duodenal ulcer constitutes a surgical emergency. The subacute perforating duodenal ulcer generally is one of pronounced activity causing varying degrees of penetration through the wall of the duodenum. In the advanced case the entire thickness of the duodenal wall has been eroded and the base of the crater consists of adjacent tissue, usually pancreas. When an ulcer of such pronounced activity is present it is unlikely that medical management will result in satisfactory cure.

Failure of medical management to relieve symptoms of ulcer long has constituted an indication for surgical treatment. Care must be exercised however in determining just when failure of medical management has occurred. One should be confident that an adequate regimen has been followed.

Occasionally uncertainty will exist regarding the exact diagnosis in a case of duodenal ulcer. This occurs most often when the lesion is situated at the pylorus and the roentgenologist is unable to say whether it is actually in the duodenum or on the gastric side of the pylorus. A small carcinoma in this vicinity may closely simulate a duodenal ulcer. If any doubt exists as to the benignity of the lesion surgical exploration should be advised. Thus, if an obstructing lesion at the outlet of the stomach is

thought to be a duodenal ulcer but the gastric acidity is low and perhaps free hydrochloric acid is absent, exploration should be performed.

Besides these primary indications for surgical treatment of duodenal ulcer there are certain factors of secondary importance the presence of which tends to favor surgical intervention. These include a very unfavorable economic status, which virtually prevents the patient from making adequate trial of medical management, the unco-operative nature of a given patient whereby the dietary regimen is not followed, excessive gastric acidity with a value of free hydrochloric acid possibly of 80 or more (Töppfer's method), a history of duration for many years and symptoms of marked severity. While no one of these secondary factors alone should be considered to constitute a definite indication for operation, when two or more of them exist in the same case, thought should be given to the advisability of operation.

Although one hears many words of condemnation for gastroenterostomy many patients have experienced an eminently satisfactory result after this operation. It seems that this fact should be kept in mind because if this operation is performed with proper indication and its technical execution is correct, good results may still be expected in a large majority of cases. True the possibility of occurrence of jejunal ulcer always remains, but that possibility also exists to a less extent after gastric resection. It should be remembered that in the hands of the average surgeon, gastroenterostomy entails a definitely lower operative risk than does gastric resection.

Gastroenterostomy may be performed as an operation of choice or at times as one of expediency. The patient who qualifies in the former category would be as a rule, of advanced years would constitute a poor surgical risk would have a chronic lesion of long standing perhaps causing obstruction because of sclerotic changes would have relatively low gastric acidity would present a single lesion and no appreciable associated gastritis and would exhibit a minimal neurogenic factor. At times gastrojejunostomy may be employed in the absence of many of the conditions just mentioned if the technical aspects of gastric resection involve too great difficulty or hazard. Such may be the case in dealing with an ulcer deeply placed in a shortened duodenum which permits neither removal of the ulcer and satisfactory closure of the duodenal stump without jeopardizing the common bile duct nor section of the duodenum immediately distal to the pylorus and satisfactory closure of the duodenal stump. This type of lesion in an obese individual with a high lying stomach and deeply placed duodenum makes resection more difficult and hazardous and therefore, may make advisable something less desirable than the surgical procedure of theoretic choice. As the surgeon's experience increases technical considerations of this type become less of a factor in his choice of operative procedure.

While there is more than one way of making a gastrojejunostoma that will permit satisfactory

gastric motor function the preferred type is as follows. The stoma is placed on the posterior wall of the stomach and is extended almost from the lesser curvature down to the greater curvature in a line running approximately from the patient's right shoulder to his left foot with the proximal jejunal loop fixed to the lesser curvature of the stomach and the distal loop joined to the greater curvature. The point at which the distal jejunal loop is attached to the greater curvature of the stomach should be directly below the angle of the lesser curvature. One should remember that an enlarged obstructed stomach will decrease in size after relief of the obstruction with a corresponding decrease in size of the gastroenteric stoma. Two or three rows of sutures may be used. Fine suture material is preferred. The stoma in the jejunum should be placed directly opposite the mesenteric border. Less than 5 cm. of stomach or jejunum should be inverted into the gastroenteric lumen particularly at the point at which the distal loop of jejunum leaves the stomach.

The retrocolic type of anastomosis is preferred. The transverse mesocolon should be sutured to the gastric wall at least 2 cm. removed from the site of anastomosis around the entire stoma. The surgeon must be certain that these sutures actually are placed in the gastric wall in the region of the greater curvature and not in the gastroduodenal omentum. This requires that several sutures be passed through the gastroduodenal omentum and into the anterior gastric wall at the lower angle of the anastomosis. A short proximal jejunal loop should be used, one just short enough, perhaps 8 to 10 cm. in length to permit approximation of the jejunum to the lesser curvature of the stomach without tension yet without appreciable redundancy. At the conclusion of the operation the distal loop of jejunum should be placed so that it lies to the patient's left in the region of the root of its mesentery.

Until vagotomy has had time to prove itself gastric resection probably should be used in approximately 5 out of 6 cases of duodenal ulcer. Resection is not an ideal procedure for treatment of duodenal ulcer and it is possible that as time passes this procedure may be supplanted gradually by one or more forms of medical or surgical treatment. At present the ideal patient for gastric resection would be a man of middle age in good general condition who has failed to obtain relief despite careful and prolonged adherence to a medical regimen whose gastric acidity is high, who perhaps has experienced recurrent hemorrhages and who has an active lesion for which resection would not be unduly difficult or hazardous. The presence of multiple ulcers and associated gastritis, as well as of a large neurogenic element would favor resection rather than conservative operation, however none of these factors makes for a favorable postoperative result.

The Billroth I type of anastomosis is preferred to the Billroth II. More specifically preference is for the Schoemaker modification of the Billroth I type, in which resection of the stomach is carried higher

along the lesser curvature than the greater curvature and the end of the stomach after closure of the lesser curvature to the desired point, is anastomosed directly with the end of the duodenum. To accomplish this operation one must have an adequate amount of duodenum distal to the ulcer that can be mobilized with a good blood supply. Anastomosis must be accomplished without tension and without limitation of resection of the desired amount of stomach. The end of the gastric stump is so formed, by appropriate closure of the lesser curvature, that its size corresponds with that of the duodenum. The amount of stomach and duodenum incised into the gastroduodenal stoma should be small in order that an adequate gastric outlet may be maintained. Although crushing clamps may be used, the author's preference is for the so-called open anastomosis performed by the use of rubber-covered Doyen forceps.

In a Billroth II type of resection it has been well demonstrated that short-loop retrocolic anastomosis is followed by results superior to those obtained when long-loop antecolic anastomosis is employed. This latter type which is technically easier to perform, at times may be used for expediency if the patient is fat, the transverse colon short and thick, and the stomach is small and in a high position. Entericanastomosis between the jejunal loops is unnecessary and undesirable. One may anastomose the entire end of the stomach with the jejunum, or only a part of it after closure of the portion bordering the lesser curvature according to the method of Hofmeister; the latter procedure is the favored one. None of the prepyloric portion of the stomach should be permitted to remain. Removal of the duodenal ulcer itself is unnecessary so long as satisfactory closure of the duodenal stump is obtained. In practice the ulcer is removed almost invariably. Satisfactory closure of the duodenal stump is most important; likewise it is essential that there be no aspliation or other factor which might interfere with free emptying of the proximal jejunal loop, as increased intraluminal duodenal pressure predisposes to leakage from the duodenal stump. The same technical points discussed in connection with gastroduodenostomy apply in establishing gastrojejunal anastomosis after gastric resection, namely approximation of the jejunum and the stomach, direction of jejunal loops, length of the proximal jejunal loop, and suturing the transverse mesocolon well back from the anastomosis.

At present, probably no two gastric surgeons would offer an identical group of indications for vagotomy in the treatment of duodenal ulcer. In general the author believes that at this time the operation should be reserved for the exceptional type of patient who has duodenal ulcer.

Gastric retention may occur after transabdominal vagotomy performed for duodenal ulcer even though preoperatively there was no indication of gastric obstruction as shown by clinical or laboratory investigation. Such retention may be severe enough to

require gastroenterostomy. Because of this fact transthoracic vagotomy seldom seems indicated in the treatment of duodenal ulcer. If this viewpoint is accepted transabdominal vagotomy performed in association with gastroenterostomy would constitute the alternative and more desirable procedure. Evaluation of late results of this method of treatment will require the lapse of a number of years. The abdominal approach presents the advantage of permitting direct examination of the lesion and exploration of the entire abdomen. It has the disadvantage until the surgeon has gained considerable experience of making complete resection of all branches of the vagus nerves somewhat less certain.

A prerequisite to the performance of vagotomy is accurate knowledge of the anatomic location and distribution of the fibers of the vagus nerves both above and below the diaphragm. Failure to section all fibers of these nerves can lead only to confusion and unsatisfactory results.

If a transthoracic approach is employed resection of a generous portion of the left eighth rib affords fine exposure. Occurrence of a pathologic process previously in the left side of the thorax adds to the difficulties and in certain cases may make a right-sided approach more desirable. A generous portion (preferably 3 cm. at least) of each vagus nerve should be resected and an effort made to prevent realignment of the nerve ends should regeneration occur.

In the abdominal approach a left-sided incision although it is not essential, aids in obtaining good exposure of the esophagus. Several inches of esophagus should be cleared and extreme care exercised to perform wide resection of all branches of the vagus nerves. A soft rubber catheter or a strip of gauze on which caudal traction is made after it is looped around the esophagogastric junction is helpful in obtaining adequate mobilization and exposure of the esophagus. Mobilization adequate to permit rotation of the esophagus in an arc of at least 180 degrees is essential. All tissue removed should be examined microscopically to aid in the thoroughness of the operation and in the ready recognition of the fibers of the vagus nerves.

Volvulus of the Sigmoid Colon and Its Treatment. CHRISTIAN BRUNSGAARD *Surgery* 1947 33 466.

The author studied 91 patients with volvulus of the sigmoid colon who had been admitted to the Ullevaal Hospital Oslo Norway. Believing that in most cases of sigmoidal volvulus there is torsion of the sigmoid with obstruction of the lumen without strangulation and/or serious circulatory disturbances the author advocated and described a successful nonsurgical method of treatment.

The conditions predisposing to volvulus formation are (1) a long and freely movable sigmoid colon (2) a long and freely movable mesosigmoid and (3) a sigmoid loop whose limbs lie close together. The last condition is encountered in a mesosigmoid with a small fixation angle to the posterior abdominal wall, or may be caused by a shrinking mesosigmoid.

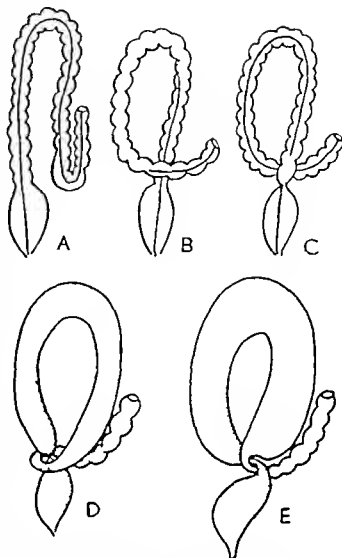


Fig. 1 (Brunsgaard). A, Long sigmoid. B, physiologic volvulus. C, axial torsion of rectal loop of sigmoid in 180 degree volvulus without strangulation of vessels. D, 360 degree volvulus of sigmoid with beginning strangulation. E, 360 degree volvulus with torsion and strangulation.

th. Sixteen of 18 patients who were either operated upon or examined postmortem had striking mesosigmoiditis.

The most moderate form of sigmoidal volvulus is the so-called physiologic volvulus—on with a clockwise asymptomatic torsion of 180 degrees. This usually corrects itself spontaneously and does not exhibit signs of intestinal obstruction. In 180 degree counterclockwise torsion of the sigmoid there occurs intestinal obstruction with circulatory changes. It is believed that volvulus which causes symptoms develops from the asymptomatic 180 degree physiologic volvulus in most cases. The rectal loop which lies behind the colonic loop may be gradually filled with gas and stool because of retention. The heavy rectal loop then changes its position and falls in front of the emptier colonic loop. This torsion of 360 degrees is accomplished. Volvulus of more than 360 degrees occurs rarely.

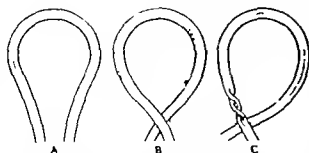


Fig. 2. Development of torsion stenosis. (From Laurell.)

Groth demonstrated that every torsion of the sigmoid and its mesenteric axis is combined with an axial torsion of the bowel itself. This axial torsion is twice as great as the torsion of the mesentery. Thus the axial torsion is 360 degrees in a 180 degree volvulus. The twisting at the axis of the mesentery and the axial torsion about the axis of the bowel which are characteristic of volvulus cause a mechanical ileus in most cases. When the torsion is moderate a simple type of obstruction occurs. In simple obstruction the intestinal wall is adequately well nourished for the first few days because the sigmoid is most resistant to increasing intestinal pressure.

When the volvulus produces a strangulation ileus, venous stasis occurs. Later depending on the degree of torsion, thrombosis of the mesentery develops and extends. The strangulated intestinal loop may become gangrenous and perforation with resultant peritonitis may occur.

Distention is most marked in instances of a competent ileocecal valve forming a so-called "closed loop." In these cases the small intestine functions normally for some time with resultant moderate loss of fluid and electrolytes. In the more severe cases there is considerable loss of fluid and electrolytes because of the formation of ascites, hemorrhage and vomiting. Exudation in the peritoneal cavity is common. A fecal odor signifies grave changes in the sigmoid colon.

The treatment is either nonoperative or surgical. Spontaneous untwisting of the sigmoid colon may occur when torsion is less than 360 degrees. In torsion of 360 degrees the twisted loop is usually held fast between the anterior and the posterior abdominal wall. Detorsion may occasionally follow a simple or a diagnostic barium enema.

The author has successfully employed proctoscopy and intubation with a rectal tube 60 cm. long and 6 to 10 mm. in diameter 123 times in patients suffering from acute volvulus but without evidence of serious circulatory disturbances in the sigmoid. A sigmoidoscope is introduced to the site of the torsion with the aid of careful inflation. The site of torsion is easily recognized by the characteristic spiral folds. Then a lubricated soft rubber rectal tube is introduced past the site of obstruction without force. Following the passage of the tube there occurs prompt evacuation of flatus and soft feces, and the patient

experiences instant relief. The tube is left in place for 3 to 5 days and is held in place by a suture to the perianal skin. In 9 instances attempts at intubation by proctoscopy were unsuccessful, but without ill effects to the patient. These patients, however, were operated upon immediately after proctoscopy.

Proctoscopy and intubation while effective in the treatment of the acute attack of volvulus, have no effect on the tendency toward recurrence of this lesion. This therapeutic method is therefore not a definitive treatment. Thirty-one of the author's patients had to be readmitted to the hospital and treated two or more times for recurrent volvulus. Only 7 patients with recurrent volvulus were treated by a four stage operation (cecostomy, a Mikulicz procedure, closure of sigmoidostomy and closure of cecostomy).

Recently at the Minnesota University Hospital, Minneapolis, the author observed 2 patients with volvulus of the sigmoid reduced by proctoscopy and intubation. About 2 weeks after the acute volvulus had been reduced these patients underwent a successful primary resection of the sigmoid. As a result of this observation, Brunsgaard now believes that primary resection of the sigmoid colon is superior to the four stage operation employed at the Uppsala Hospital and should be employed when surgery becomes necessary. ROBERT TUNELL, M.D.

Multiples Polyps of the Colon with Malignant Change Involving Colon and Appendix. BRUNO MANN and N. CHANDLER FOOT, Ann. Surg. 1947 126 363

This article consists of a very well documented case history of multiple polyps of the colon, cecum, and vermiform appendix with malignant change involving the colon and the appendix. It is followed by a brief discussion of this unusual condition.

The patient, a 35 year old female, entered the hospital as a very poor surgical risk due to prolonged blood loss. Following intensive preoperative therapy the authors were able to perform a transverse colectomy. This placed the rectum at rest and permitted the removal of polyps from the splenic and hepatic flexures for microscopic study. The result of this operation led to marked improvement in the patient's general condition.

Next a right hemicolectomy and ileotransverse colonic anastomosis were performed. The resected specimen revealed multiple polyps, both malignant and nonmalignant, as well as a well developed carcinoma of the cecum in addition a malignant adenoma of the vermiform appendix was found.

Finally the authors performed a perineal resection of the rectum and lower sigmoid and then the stoma of the transverse colectomy was closed. This entire formidable procedure totaled 118 hospital days.

The authors discuss carcinoma of the appendix and point out the great rarity of this condition and its frequent confusion with carcinoids of the appendix, a neoplasm which histologically resembles carcinoma but acts clinically as a benign tumor.

EDWARD F. LEWISON, M.D.

Carcinoma of the Colon. ARTHUR W. ALLEN, CLAUDE E. WELCH and GORDON A. DONALDSON Ann Surg 1947 126 19

The authors present the data on 105 patients with carcinoma of the colon who were treated since January 1, 1943. This series does not include those with carcinoma of the rectum. Resectability was possible in 95 per cent of the cases.

The period of invalidism following colon resections is dependent on many factors. In spite of the fact that a 2 stage attack is often necessary in the presence of acute obstruction, final resection followed by primary anastomosis has been more satisfactory in the authors' hands than exteriorization procedures. Since the introduction of the Miller Abbott tube and the use of sulfasuxidine and sulfathaladine in the preparation of patients for colon resections, fewer patients have needed cecostomy. In acute complete obstruction and on occasion this procedure is supplemented with complete transverse colostomy. The latter type of decompression is particularly adaptable to extensive inflammatory reaction about the initial lesion. Although rarely necessary in the preparation of patients with cancer of the left colon it is justifiable in doubtful cases and is essential in diverticulitis with obstruction or abscess formation. Complete colostomies are best managed by final excision of all scar tissue and an accurate end-to-end anastomosis with the bowel dropped free into the peritoneal cavity.

The added benefits of chemotherapy have doubtlessly played a role. Carefully controlled anesthesia, blood replacement and better technical surgery have been the chief reasons for better results.

On admission, a patient with suspected cancer of the colon should have the following studies in addition to a careful physical examination and history. A plain film of the abdomen will often reveal the approximate site of the lesion by the gas pattern. This is true particularly when obstruction of any degree is present. If this fails to give a lead one should then proceed with a careful sigmoidoscopy. If the lesion is not visualized a barium enema must be used. The patient's anemia and electrolyte balance are evaluated and proper therapy is instituted to correct them.

Sulfathaladine is as effective in the preparation of the bowel for surgery as is sulfasuxidine. Occasional bleeding from the growth has not been noted when this drug was used but it was observed when sulfasuxidine was in use. The recent finding by Poth that sulfathaladine and penicillin are antagonistic must be borne in mind.

The early favorable changes observed following the removal of an infected obstructing lesion are spectacular. Such aids as blood plasma, and amigen appear more effective postoperatively although the patient's ability to utilize an unobstructed gastrointestinal tract is probably the chief reason for this impression.

Incisions vary to some extent according to previous bowel drainage and the location of the tumor

In primary right colectomy a long right paramedian incision was found more satisfactory as this allowed adequate exposure of the vascular source and nodal spread. Transverse incisions are preferred for the flexures and lesions involving the midcolon. The left colon exposures have been paramedian in cases in which permanent colostomy might prove necessary. Oblique incisions with mesial retraction of the rectus muscle were satisfactory for low sigmoid tumors suitable for end-to-end primary anastomosis. Delayed primary wound closure was practiced with a minimal of wound infection.

Resection of the involved bowel and mesentery was wide on the cephalward side in all instances. In lesions of the left colon the distal segment has been adequate to include any extension of disease into the surrounding tissue. The bowel was divided between thin clamps in the proximal portion early in the procedure.

Instead of isolating the blood vessels to insure viability the disease was removed and the adequacy of the blood supply to the end-to-end anastomoses was determined by visualization. Contact structures were removed with the primary tumor en bloc. These have included all the nonvital organs or parts of them within the abdomen and pelvis. The open method was used in all operations of election.

The rent in the mesentery is carefully closed on both sides when the anastomosis is completely within the peritoneal cavity. If pelvic dissection has been necessary the lateral margin between the bowel and pelvic peritoneum is left open. This obviates the draining of this region through the ischial foras, as formerly practiced. Fistula formation with resultant stenosis of the suture line is thereby avoided. Collections of serum in the hollow of the sacrum may burst into the peritoneal cavity with a transient intraperitoneal reaction. As a rule however seepage from this space is gradual and is adequately handled by the peritoneal cavity.

In suitable patients, dicumarol was used postoperatively to prevent venous thrombosis. However many patients were arteriosclerotic or had other contraindications to the anticoagulant drugs. In these prophylactic superficial femoral vein interruptions were practiced. If the lesion is well above the pelvic floor this procedure can be done before or at the time of the bowel resection. If however pelvic dissection is necessary then the vein interruption should be postponed for 48 hours after operation. There is a transient engorgement of the pelvic veins immediately following femoral vein interruption that definitely increases the blood loss during the pelvic dissection.

The average hospital stay in this series of cases was 35.4 days. The average number of postoperative hospital days was 6. There were 36 cases requiring preliminary bowel drainage or some 2 stage procedure. These averaged 39.9 days in the hospital, while those requiring no second stage averaged 24.8 days.

LEE PULLEN, M.D.

Management of Colostomies Performed for War Injuries. HALL G. HOLLIER and EDWARD F. LEWIS. *Am. J. Surg.* 1947 120 253.

The authors report their wartime experience with 67 colostomies in patients treated by means of definitive surgery in an Army hospital in England and draw a parallel between this experience and the current trends of colon surgery in civilian practice.

Colostomy closure in battle casualties presented many difficulties which are usually not encountered in civilian practice. First among these were the patients with multiple injuries. Such injuries frequently produced superimposed infections, concurrent sepsis, impairment of vital organs, and general debility. Also the initial surgery was performed by surgeons in the forward area under the most difficult and trying conditions. Under these circumstances the exact construction of the colostomy was often not very clear to those who had to do the subsequent reparative work.

An analysis of the collected material reveals the site of injury to be as follows: right colon in 13 cases, transverse colon in 9, left colon in 13, rectosigmoid in 37 and rectum in 7 cases.

Despite the fact that the Army strongly recommended simple exteriorization as the operation of choice for large bowel wounds, the types of colostomy performed are: cecostomy 11, double-barrel-(Mikulicz) 43, loop (exteriorization) 16.

The types of colostomy closure are tabulated by the authors and the preoperative, operative, and postoperative details of technique are outlined and discussed. The results were satisfactory in all but one patient who was evacuated to the Zone of Interior with a persistent fecal fistula.

The authors believe that in colostomy closure an end-to-end (either open or closed) anastomosis is preferable to the spur-crushing technique. In peacetime surgery primary anastomosis of the colon is finding an ever widening circle of acceptance.

Emphasis is placed upon the surgical triad which, in the opinion of the authors, accounted for their satisfactory end results: firstly efficient therapy directed toward improving the patient's general condition prior to operation, secondly the use of chemotherapeutic agents, and lastly the operative care and improvement in surgical technique.

Colostomies, whether they be the result of battle casualties or commonplace conditions of the colon, should be closed at the earliest opportune time.

EDWARD F. LEWIS, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Biliary Neura (Neurobilia). FRANCISCO J. VIANO and LUDIG G. MOSCA. *Dis. med. B. Afr.* 1947 19 1559.

Biliary Neura is an uncommon occurrence and only 70 cases appeared in the Argentine literature and no more than 300 cases have been reported elsewhere. The authors report the cases of 2 patients 84 and 85 years of age respectively. Both were cured.

In the mechanism of its production in the greater number of cases the calculus proceeds from the gall bladder and migrates through a cholecystoduodenal fistula. In a smaller percentage the migration is through a cholecystogastric fistula, and in a still smaller percentage migration occurs through the common bile duct. Biliary Neura is fundamentally mechanical, although one should also bear in mind the factor of intestinal spasm produced by pressure of the calculus. In the majority of cases these calculi have localized in the terminal end of the ileum, but they can be detained at any other point of the intestinal tract. The calculus may reach the dimensions of 3.5 cm. in width and 7 cm. in length while its shape may be spherical, oval, cylindrical or conical. Spontaneous expulsion of the calculus is possible although infrequent.

The symptoms and signs usually found are as follows: pain is usually localized at the onset in the upper abdomen, right hypochondrium, or epigastrium vomiting at first is gastric, then liquid and bilious, and later black and malodorous, there is stoppage of the intestinal gases and later distention.

The symptoms and signs not usually found are namely: palpable tumor formed by the calculus itself or by an afferent loop of bowel, hematemesis and melena, massive and sudden emptying of the intestine due to the peristaltic stimuli produced by the calculus, right lateral decubitus, disappearance of a palpable gall bladder, migration of pain with the calculus, hiccups, and vomiting of the calculus.

Evolution of the condition is as follows: it begins as a typical hepatic colic or pyloroduodenal stenosis then there is a period of intermittent occlusion, a period of irreversible obstruction, and, last, a period of complications.

Röntgenologically the condition may be diagnosed by direct localization of the calculus or dilated intestinal loops and by verification of the cholecystoduodenal fistula.

In spite of the facts that surgical intervention is simple and that the circulation of the loop of bowel is not seriously affected, biliary Neura has the most severe prognosis and the highest mortality of all intestinal occlusions.

Once the diagnosis is made or suspected, surgical intervention should be immediate. The procedure of choice is enterotomy, the incision being made either over the calculus or directly above or below in the healthy bowel. The incision should be longitudinal, but should be sutured transversely. Anesthesia should be of the local type.

ARTHUR F. CIPOLLA, M.D.

MISCELLANEOUS

The Effect of Heparin upon Intra Abdominal Abscesses in Rabbits. B. M. BLOOR, HUTCH DORTCH, JR., T. H. LEWIS, R. F. KIRKLE, and K. S. SHEPARD. *Ann. Surg.* 1947 76 324.

This is a report of an investigation on the effect of heparin upon the formation and reformation of ad-

hemions in rabbits. The adhesions were formed through a laparotomy incision by freeing and scarifying the antimesenteric border of the appendix. In the series in which heparin was used 15 mgm. of heparin were placed in the abdomen at the time of the operation and a second peritoneal injection of 15 mgm. was given 24 hours after the operation. In some heparin treated rabbits Pitkin's menstruum was used.

The authors conclude from their investigation that the likelihood of developing adhesions was almost as great in the rabbits treated with heparin as in those that were not treated with this drug.

F J LEREMANN JR. M.D.

Retroperitoneal Cysts. H MINOR NICHOLS. *Ann. Surg.* 1947 126 340.

A discussion of the various theories concerning the origin of primary retroperitoneal cysts is presented. The author also reports a case in which there was a palpable mass in the right lower quadrant of the abdomen. A differential diagnosis was

made and the diagnosis of retroperitoneal cyst was made before operation.

Microscopic pathology revealed a diffuse irregular anastomosing series of tiny cleftlike and well formed channels lined by typical endothelial cells. The cyst was also in direct continuity with a large area of typical angiodoma.

An effort has been made to classify these cysts embryologically. In quoting the literature, one author states that there are approximately 500 case reports on omental cysts and only 18 on mesenteric cysts.

The variety of findings microscopically in the wall of the cyst is due to the fact that the tumor arises out of one of the many portions of the wolffian body.

A table is included in which 5 additional case reports not previously summarized are presented.

The diagnosis of retroperitoneal cyst is made by the process of eliminating other possible tumors. The treatment of this condition is entirely surgical.

Five illustrations are also included in the article.

RICHARD J BENNETT JR. M.D.

GYNECOLOGY

UTERUS

Investigations into the Uterine Mucosa. Pathologic and Clinical Classification of Metropathia Hemorrhagica. BERTIL FALCOVER. *Acta obst. gynaecol.* 1947 27 S pp. 5

On the basis of endometrial biopsy the author divides cystic glandular hyperplasia into 4 phases as follows:

Group I. Commencing or weakly marked phase. There is an abundance of glands which are crowded and show invagination and dilatation. The cells are high columnar and contain elongated nuclei and localized stromal hyperplasia is present.

Group II. Cystic glandular hyperplasia with the microscopic picture of the classical hyperplasia.

Group III. Cystic glandular hyperplasia with secretory activity. The picture characteristic of hyperplasia but with a varying amount of lutein stimulation which may be noted both in the glands and the stroma.

Group IV. Inactive or atrophic type. The glands are cystic but there is no evidence of glandular activity and the mucosa is thin and atrophic.

The author suggests that the condition may run a cyclic course like that of the menstrual cycle and that there is a definite correlation between the clinical symptoms and the microscopic findings. As to the etiology, he ascribes the major abnormality to ovarian dysfunction from abnormal function of the neuroendocrine system. J. ROBERT WILLIAMS, M.D.

Cervical Cancer: A Disordered Growth Response to Inflammation in the Presence of Estrogen Excess and Nutritional Deficiency. J. LAWRENCE ARZEE. *Am. J. Obst.* 1947 54 365.

During the course of studying vaginal and cervical cytology smears for a diagnosis of uterine cancer it was observed that when cancer was present there was also cytologic evidence of abnormally high endogenous estrogenic activity. Recently a nutritional deficiency of thiamine was frequently found present in cases of abnormal estrogenic cornification. Three cases are presented in detail which demonstrate the combination of poor dietary habits and a low thiamine excretion level, increased cornification in the vaginal and cervical smear (high estrogen content) and the presence of an early cancer of the cervix as shown by both smear and biopsy.

With the hypothesis in mind that cervical cancer is a disordered growth response to inflammation in the presence of estrogen excess and thiamine deficiency 100 cases were studied. Fifty patients had proved cervical cancer and 50 were controls who were in good gynecological health. Cervical smears were studied for estrogenic cornification. Thiamine excretion levels were determined. In a few cases liver function tests and urinary estrogen assays were made.

Some degree of chronic cervicitis is believed to be present in 4 of every 5 adult cervixes. Eighty-two per cent of the patients with cancer had both a high cornification smear and a low thiamine excretion, while none of the controls had this combination. High cornification alone was found in 97 per cent of the cancer patients and in only 62 per cent of the controls. A low thiamine excretion alone was noted in 86 per cent of the patients with cancer and in 10 per cent of the controls. Only 14 per cent of the patients with cancer had a normal thiamine excretion while this excretion was normal in 99 per cent of the controls. A normal or low estrogen cornification smear was found in only 8 per cent of the cancer patients but was noted in 94 per cent of the controls.

A 35 year old patient showing chronic cervicitis and a low thiamine excretion level was placed on stilbestrol in moderate doses over a period of 10 weeks. This was followed by vaginal spotting of blood and cytology tests revealed cells of malignant morphology. Complete excision of the squamocolumnar circle of the cervix was made. Biopsy confirmed the presence of an early carcinoma. The cervix healed and no further change has been noted.

Thus partly by speculation and partly by interpretation of the evidence presented an attempt has been made to correlate infection, excessive tissue estrogens, and nutritional deficiency in the production of cervical carcinoma of the squamous type.

JAMES R. WOLFE, M.D.

Cancer of the Uterus. I. IL NOVAL. *J. Am. Med. Assn.* 1947 135 199.

Uterine cancer is one of the most important of gynecologic problems. No less than 17,151 women in the United States died of this condition in 1944 (the latest year for which complete figures are available). Although great advances have been made much remains to be accomplished.

Pathologists are still in the dark so far as the inciting factors transforming a normal into a malignant cell are concerned. They insist that cancer is a group of diseases, mainly because of the various histologic types found. Probably however a common denominator will some day be uncovered. Heredity certainly plays a role as does chronic irritation, whether the latter be traumatic, inflammatory or hormonal in nature. The traditional teaching is that cervical carcinoma arises in chronic irritative lesions of the cervix. On the other hand carcinoma has been found in a normal appearing cervix. This suggests that in some individuals the genetic influence is so strong that the contributory effect of irritation is unnecessary.

Estrogenic hormones have been indicted as carcinogenic but it is difficult to eliminate *post hoc ergo propter hoc* reasoning in evaluating evidence on this

score. Estrogenic stimulation is of some importance, however since patients with a history of functional menopausal bleeding, a delayed menopause or post menopausal endometrial hyperplasia have a higher than usual incidence of corpus carcinoma. It is advisable to avoid the use of estrogenic substances in women who because of heredity or some other factor have a suspected predisposition to this disease.

The term precancerous has two different meanings (1) lesions chronologically preceding cancer e.g. chronic cervicitis and (2) what has been variously termed as preinvasive carcinoma, intraepithelial carcinoma, carcinoma *in situ* and Bowen's disease of the cervix. Most discussion centers around the malignancy of the latter interpretation of the term. Although the cells concerned are malignant in appearance, invasiveness has not yet occurred. Novak believes that preinvasive carcinoma is the beginning stage of cervical carcinoma and that this stage may be of extremely variable length. During this time the cancer is "benign" and is curable by simple excision. If a single biopsy shows preinvasive cancer further sections of adjacent tissue will often show invasiveness.

In the body of the uterus one may encounter lesions which histologically present all stages between benign hyperplasia and adenocarcinoma. At times it may be almost impossible to differentiate microscopically the benign from the malignant. The author believes that hyperplasia in itself is benign but when it occurs in a postmenopausal woman it predisposes to adenocarcinoma.

There are three more or less recent aids to the diagnosis of uterine cancer. Colposcopic examination as introduced by Hinselmann in 1937 is time-consuming and not very popular. The functional test of Schiller suggests promising points for biopsy. The most heralded and promising diagnostic adjunct is the Papanicolaou smear technique. Its main limitation is the necessity of its interpretation by trained cytologists. As a screening method in presumably normal women it will probably find its greatest field of usefulness. Biopsy and curettage still remain the most dependable means of diagnosis.

Previously in treating cervical carcinoma the gynecologist merely decided (considering both the general and local condition of the patient) whether he was justified in operating. The personal equation was necessarily an important part of the decision. The primary mortality even with the most expert was high. Medical advances such as transfusion, chemotherapy and biophysics were of course not available. Also distressing sequelae as ureteral and bladder injuries with and without fistula formation, were not infrequent. Radium was at first considered merely a palliative measure. It too was occasionally accompanied by serious injury to neighboring structures. Gradually with more intelligent use it became apparent that radium was at least as effective as surgery. Immediate mortality is almost nil.

At present the trend in the therapy of cervical malignancy seems to be toward both radiation and

surgery. Details vary but it is generally conceded that preliminary radiation lessens infection in addition to devitalizing and entrapping cancer cells in fibrous tissue. The surgical procedure may be a true radical Wertheim operation, a panhysterectomy including a large cuff of vaginal mucosa and a great portion of the parametrium or merely a pelvic gland dissection. It is too early to completely evaluate the various methods but it should be emphasized that surgery is applicable to a small number of cases (in only 10 per cent of cases are the lesions of stage I).

Because of the slower extension of the lesion, the less radical operation required the higher cure rate surgery has always played a prominent role in the treatment of corpus carcinoma. At present, preliminary irradiation and then surgery are employed in the majority of clinics. The radiotherapy may be radium x ray or both.

The author concludes that the surest and safest treatment of uterine carcinoma is prevention and lacking this, early diagnosis. Unless the physician takes each case as a personal responsibility and conscientiously directs his patient to the best care available the mortality from uterine cancer will not recede. Education of both layman and physician is vitally necessary. WARREN R. LANE, M.D.

Radium Therapy of Cancer of the Uterine Cervix and of the Fundus. ROBERT E. FRICK, *Surg. Clin. N. America* 1947 27 775

Cancer of the cervix presents too complex a problem for the radiologist alone. The importance of early diagnosis cannot be overstressed. Once a malignant lesion is suspected, the patient is best seen at a clinic. Following a thorough general and pelvic examination, the patient is seen by the surgeon and the radiologist, and the best possible treatment for the individual case is outlined. Co-operation of the clinician, pathologist, radiologist and surgeon is essential.

The plan of radium treatment at the Mayo Clinic is defined as an intensive broken dose method. A 50 mgm. platinum filtered tube is the unit of treatment and the average advanced lesion receives a total dose of 7,000 to 8,000 milligram hours throughout the entire birth canal in approximately eight applications in a period of 3 weeks. At the start treatments are applied twice a week and more rapidly thereafter the exact interval depending on the visible response of the tumor.

The main principles of treatment are (1) homogeneous irradiation of the entire birth canal by fairly short repeated treatments (2) avoidance of trauma in probing the canal and inserting the tube (3) use of the knee-chest position to secure adequate exposure and to avoid trauma during the necessary manipulations, (4) use of adequate gauze packing above the tube to increase the distance of the intestinal wall from the element, and (5) adequate follow-up studies of each patient over many years.

After the radium treatments, a supplementary course of roentgen therapy is given at 200 kilovolts

and with 550 roentgens measured in air to each of four fields in the hope of sterilizing the parametrial regions. In stage 3 or 4 lesions, the course of roentgen therapy is repeated 3 months later.

A review of several hundred cases in which radium treatment was used showed that patients with stage 1 lesions had a 69.5 per cent 5 year survival rate, stage 2 60.5 per cent stage 3 50.7 per cent and stage 4 6.5 per cent. These results concerned patients not treated before admission. Results in the

modified cases in which the patient came to the Clinic after some treatment elsewhere were less satisfactory. This modified group formed a large portion—415 patients of the total of 1,491. Five year arrest of the cancer in stages 1, 2, 3 and 4 was 100 per cent (only 4 cases), 56 per cent, 10.8 per cent and 4 per cent respectively, of the patients treated. The 5 year survival rate of all patients primary and modified, with cancer of all stages was 36.8 per cent of the 1,352 patients traced.

During the first course of treatment the main complications encountered in 3 or 6 per cent of patients have been due to spread of infection or to hemorrhage. All cervical cancers are infected when first seen the topical application of bactericidal agents during the course of treatment clears up the majority of localized infections. Occasionally however pelvic cellulitis spreads, eventuating in a pelvis abscess or peritonitis. Cancer therapy is then stopped and measures are taken against the infection. The recent development of sulfonamide drugs and penicillin has undoubtedly cut down the treatment mortality rate even though in former years this has averaged only 1 per cent. Once the spread of infection has been halted and the elevated temperature of the patient has returned to normal cancer therapy may be resumed sometimes after a rest period of 3 or 4 weeks.

In treating hemorrhage associated with cervical carcinoma, tight packing of the vagina with gauze every other day while proceeding with radium treatments will control the condition. After several radium treatments a few days apart enough connective tissue forms to stop the excessive bleeding. Hemorrhage is a serious complication. Some patients when first seen are so exsanguinated that transfusions and other supportive measures are necessary before cancer treatment can be started. Anemic tissues also heal more slowly than normal tissues.

Complications which appear during subsequent visits of the patient are usually due to spread of the malignant lesion, uncontrolled by the previous radium therapy. They are usually due to lateral parametrial spread or to metastasis. One ureter may be occluded by the presence of cancer in the region of the broad ligament, and result in hydronephrosis and hydronephrosis and finally in a nonfunctioning kidney. When both ureters are occluded death from uremia ensues and is the most common cause of death in uncontrolled cervical cancer. When one kidney is functionless palliative radium therapy may delay the fatal outcome. Other late complications are rectovaginal and vesicovaginal fistulas. Occasionally de-

layed healing of tissues following radium therapy results in the formation of craters at the site of the cervix covered with infected slough. The application of radon ointment to these craters has appeared to promote healing in several instances. Very occasionally pyometra may be found dilatation of the cervix with a rubber catheter and irrigation of the uterus with antiseptic solutions usually is effective.

These late complications are often seen in stage 4 lesions before any radium therapy has been given and they should be thoroughly studied. Whenever excessive pelvic infiltration is determined, excretory urograms and blood urea determinations should be carried out. Limited radium therapy usually affords some palliation in the presence of these late complications.

Because of the nature of cancer of the body of the uterus, characterized by slow growth and delayed metastasis surgical removal of the uterus usually achieves a cure. Complete hysterectomy not as radical or difficult an operation as the Wertheim hysterectomy successfully eradicates the cancer.

Radiologists are interested in two groups of cases of this form of malignant lesion: those in which the lesion has extended widely before the diagnosis was established so that surgical treatment is no longer feasible (stages 3 and 4), and those in which the lesion is still small but the patients themselves are poor operative risks because of other coexisting serious illnesses.

The underlying principle of treating cancer of the corpus uteri is as with cancer of the cervix homogeneous irradiation of the entire birth canal employing the intensive broken dose method. Following the diagnostic curettage, two 50 millicurie radon tubes in tandem formation filtered with 0.5 mm. of silver and enclosed in a 1 mm. brass tube on a long copper wire are introduced to the depth of the uterine canal for 24 hours. With the patient in the knee-chest position the applicator can be readily introduced with little trauma. The radon tubes fit into a narrow brass applicator when radon is not available. Two 50 mgm. tubes filtered with 5 mm. of platinum in a brass capsule of 0.3 mm. wall thickness are used. The wire is wound up in the gauze which is packed above the cervix filling the vagina and elevating the perirectal tissues to a safe distance. About a week later a second tandem is used this time in the midportion of the uterus. It is placed by introducing the applicator to the depth of the uterus, then withdrawing it about 3 cm. and bending the wire where it emerges from the cervix. Again the two 50 millicurie radon tubes are left for 24 hours. If the uterus is very large three tandems may be employed in different positions but with some overlapping thus the interior of the uterine corpus receives from 4,800 to 7,200 millicurie hours in a period of 3 weeks. With two intracavitary tandems the more usual treatment, at 1 cm. depth from the midline of the tubes the dosage varies from 5,200 gamma roentgen at one end of the applicator to between 11,000 and 21,000 gamma roentgens at the midpoint of the applicator depending on the

amount of overlapping. In addition to the intra-uterine treatments, a deep cervical canal treatment of 50 mgm. filtered with 1 mm. of platinum is placed for 14 hours and two or three vaginal applications of 50 mgm. each filtered with 1 mm. of platinum and 1 cm. of hard rubber are placed across the face of the cervix and in the right and left fornix on different days for 14 hours each.

The foregoing is a condensed description of a complete treatment given when the lesion appears to be small and cure seems possible. It is given in a period of 3 weeks more than one intrauterine treatment a week is never applied. Cervical and vaginal treatments may be given in the interval. The radium treatment is followed by a course of high voltage roentgen treatment 200 kv. 30 ma. 50 cm. distance, large fields, 550 roentgens per field for four to six fields around the pelvis, one field a day. The roentgen therapy may be repeated 3 months later in the more extensive cases.

In extensive lesions limited radium therapy designed for palliation only consists of the use of only one tandem and perhaps vaginal applications to shrink the growth and reduce pressure.

The results of radium treatment of cancer of the corpus uteri have been surprisingly good. Of course, the 5 year salvage depends on the percentage of stage 1 and stage 2 lesions referred for radium therapy. At the Mayo Clinic, the 5 year survival rate mounted from 12.63 per cent to 39 per cent when a greater percentage of less advanced lesions were treated. Study of the microscopic grade of the lesions yielded an interesting prognostic factor. Whereas in carcinoma of the cervix in which the treatment can be individualized the survival rate remained essentially the same for the different microscopic grades treated in cancer of the uterine corpus, in which therapy is rather standardized the grade was a very important prognostic factor. The 5 year survival rates varied from 79 per cent in grade 1 to 12 per cent in grade 4.

EXTERNAL GENITALIA

Relationship of the Vagina to the Adjacent Organs
In Reconstructive Surgery. A Histologic Study
J. V. Ricci, J. R. Lina, C. H. Tuom and W. L. Krom
Am. J. Surg., 1947 74 387

Specimens consisting of the perineal body, anal canal, rectum, vagina, urethra, bladder, cervix and fundus were removed en masse from 23 cadavers (4 fetuses, 3 infants, and 15 adults). After fixation, some of these specimens were subjected to serial cross-sections, some to serial sagittal sections, and others to both following an accurate longitudinal bissection. The purpose of the investigation has been to demonstrate microscopically all the tissues between the mucosa of the vagina throughout its entire length and the mucosa of all the juxtaposed organs such as the anal canal, the rectum, the urethra, and the bladder. Further this investigation has as its purpose to prove or disprove the presence of a fascia

variously designated isolated and utilized for reconstruction of the relaxed, sagging and sacculating anterior and posterior vaginal walls. As a basis for discussion and classification of tissues, a fascia is considered a sheet of compact connective tissue of variable thickness completely devoid of muscle substance and possessing tensile strength for supportive and reconstructive purposes.

There is a complete fusion of the fibromuscular elastic wall of the vagina and the juxtaposed wall of the urethra throughout its entire length from the external urethral orifice to the trigone of the bladder. These two walls are closely integrated by interweaving strands of collagenous connective tissue and elastic fibers. No line of separation is present. But the portion closer to the urethral canal is more vascular than the portion closer to the vaginal canal. Between the urethra and the vagina there is neither cleavage plane, areolar zone nor any substance remotely resembling a sheetlike structure of compact connective tissue, i.e., a fascia.

There is a definite line of separation, a cleavage plane, an areolar zone between the anterior vaginal wall and the juxtaposed wall of the bladder from the vesicouterine fold to the trigone. This line of separation is marked by the presence of loose shreds of areolar fibers. There is no substance between the bladder and the anterior vaginal wall which in any way resembles a sheetlike structure of compact connective tissue, i.e., a fascia.

There is a complete fusion of the fibromuscular elastic structure of the outermost vaginal wall as it comes in contact with the short perineoanal canal. The point of fusion ends approximately where the anal canal continues as the rectum. Between this portion of the vagina and the perineoanal canal there is no cleavage plane, no areolar zone, no substance which in any way resembles a sheetlike structure of compact connective tissue, i.e., fascia.

There is a definite line of separation, a cleavage plane, an areolar zone between the posterior vaginal wall and the juxtaposed rectal wall beginning approximately at the anorectal junction and ending where the rectum comes in contact with the col-de-sac peritoneal reflection. The separation of these two organs is marked by the presence of loose shreds of areolar fibers. Between the posterior vaginal wall and the rectum, there is no substance which in any way resembles a sheetlike structure of compact connective tissue, i.e., a fascia.

The vaginal wall is a fibroelastic muscular structure with abundant connective tissue fibers. The muscular fibers are not separated into two distinct layers of inner circular and outer longitudinal but consist of circular and longitudinal fibers of irregular distribution. It is only in the midportion of the vagina that the circular fibers give a suggestive pattern of a definite arrangement. In the same location both circular and longitudinal fibers are "stouter" particularly in the lateral and posterior portions. These muscle fibers become lost in that portion of the vaginal wall forming the fornices and the cervix.

Inferiorly they also become lost around the introitus of the vagina and perineal body. The vascular components of the vaginal wall are abundant in the midportion and in the lateral portions of the vagina.

The mucosa of the anorectum is loosely attached by its submucosa to the muscles at the anorectal junction are ultimately integrated into the perineal body. Above the perineal body the inner and outer muscular layer of the rectum are separated by an areolar tissue as loose in texture as the submucosa and as the areolar zone lying between the rectum and vagina. The muscularis of the rectum is extremely thin becoming increasingly stout and compact as the rectosigmoid is reached.

The absence of an areolar cleavage plane between the anterior vaginal wall and the wall of the urethra, and the presence of a complete fusion of the fibromusculoelastic structure of these two organs necessitates blunt dissection of the fibromusculoelastic structure to effect a separation between the urethra and the vagina. Separation of the fused layers of tissue of these two organs invariably leads to a manageable but unavoidable general ooze.

The presence of a definite line of separation, an avascular areolar cleavage plane between the fibromusculoelastic vaginal wall and the bladder wall facilitates a clean cut anatomic and bloodless separation of these two organs if the operator enters the true avascular vesicovaginal space.

The absence of an areolar cleavage plane between the outermost portion of the posterior vaginal wall and the perineoanal canal and the presence of a complete fusion of these structures necessitates blunt dissection to effect a separation of this portion of the vagina. Separation of the fused layers of tissue of

these organs leads to manageable but unavoidable general ooze and even brisk bleeding.

The presence of a definite line of separation, an avascular areolar cleavage plane between the posterior vaginal wall and the rectal wall, beginning approximately at the anorectal junction and ending where the vaginal wall fuses with the cervix and the rectum comes in contact with the cul-de-sac peritoneal reflections facilitates a clean cut anatomic and bloodless separation of the rectum and the vagina provided the operator enters the true avascular rectovaginal space.

There is no microscopic evidence whatsoever to substantiate belief in the existence of a so-called "fascia" between the urethra and the vagina, between the bladder and the vagina, between the perineoanal canal and the vagina, and between the rectum and the vagina predicated on the basic concept that a fascia is a connective tissue sheet of variable thickness and possessing tensile strength. Such designations as urethrovaginal, vesicovaginal, pubocervical, pubovesicocervical, uteropubic, and rectovaginal fascias are gynecological misconceptions. And to dismiss the argument merely on the basis of a variation in terminology is a *reductio ad absurdum*. The gynecologist who "succeeds" in isolating these "indispensable fascias" for reconstructive purposes has split the fibromusculoelastic vaginal wall into two layers the innermost of which he erroneously designates as a fascia. Since the microscopy of the area in question shows none of these mentioned fascias, these designations should be stricken from the literature dealing with gynecological anatomy of the pelvis and that dealing with reconstructive vaginal plastic surgery.

CHARLES BASOR, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

A Rare Ectopic Pregnancy in the Left Cornu of the Uterus. ADOLF WIST *Ann. chir. gyn. fenn.*, 1947 36: 139.

The author reports a case in which a preoperative diagnosis of extrauterine pregnancy, a postoperative diagnosis of intertubal pregnancy, and a microscopic diagnosis of pregnancy developing in epithelial passages outside the tube in the cornu of the uterus was made.

The history and findings were typical of an early ruptured ectopic pregnancy with the acute symptoms developing 45 days after the last normal menstrual period. At operation a defect was present in the left cornu of the uterus through which a small piece of placenta was presenting. The left cornu and tube were resected and the entire specimen was sectioned serially.

The tube showed no evidence of inflammation or endometriosis, nor was there a decidual reaction present. The cavity containing the embryo was situated deep in the muscle of the cornu and as it was traced a number of ductules lined by a tubal type of epithelium were present in the surrounding muscle. No communication between the tube or uterus and these ductules could be demonstrated.

The author discussed the various possibilities as to how the fertilized ovum reached its site, including the possibility of erosion from the uterine cavity, endometriosis, and salpingitis isthmica nodosa, and discarded them all on the basis of his microscopic findings. He concluded that the ovum had presumably passed to its final site along passages lined with tubal epithelium and opening into the proximal third of the infundibular part of the tube. He did not demonstrate these connections. Perhaps this could have been a pregnancy which had reached its final site through an accessory tube. There were no sections made of the associated broad ligament.

GEORGE B. BRADSHAW, M.D.

Studies in Rh Isoimmunization in Pregnancy MILTON S. SACKS, WILLIAM J. KUHNS, and ELSA F. JAEHL *Am. J. Obst.* 1947 54: 400

Since August, 1945 the Rh typing laboratory of the University of Maryland School of Medicine Baltimore has made observations on 12,875 patients in 1 year. 1,635 of the patients were Rh-negative, and among these there were 96 isoimmunized women.

Erythroblastosis fetalis occurred in the offspring of 53 or 67.1 per cent of 79 isoimmunized women. Erythroblastosis fetalis was absent in the infants of 26 or 32.9 per cent of this group. The fact was emphasized that the presence of Rh-isoimmunization was not necessarily synonymous with hemolytic disease in the offspring. This disease occurred once among 215 deliveries, an incidence of 0.46 per cent in the total group of 12,875 women studied.

Of the 96 isoimmunized women 10 were primigravidae, and 86 multigravidae. Six of the 10 primigravidae had a definite history of previous transfusions. In 48.8 per cent of the multigravidae, the initial evidence of isoimmunization occurred with the second pregnancy. Initial isoimmunization in the remaining 51.2 per cent was scattered from the third to the eleventh pregnancy.

Fifty-five patients were studied in an effort to correlate parturient antibody titers with the outcome of pregnancy. When serum agglutination titers exceeded 10 units a significant infant mortality was noted. In 40 patients who were studied by the plasma agglutination technique, significant infant mortality occurred only when the maternal titers were somewhat higher. A distinct correlation between the maternal serum titers and neonatal disease was demonstrated in most instances. The duration of the existence of the parturient isoimmunized state, although of significance, was believed to be less important prognostically than the antibody titer.

The influence of labor on the antibody titer was studied in 19 patients. Eleven, or 57.8 per cent showed a significant rise in titer.

Eighteen patients who were observed from 1 to 60 months post partum were demonstrated to still have antibodies in the circulating blood. The significance of this fact for transfusion and subsequent pregnancies is noted. JOHN R. WOLFF, M.D.

Toxic Complications of Pregnancy in Gorgas Hospital, Panama Canal Zone, 1931-1945 NAYD S. SCHENKMAN, GEORGE A. CULVER, and R. A. STEVENSON *Am. J. Obst.*, 1947 54: 428.

The present investigation is an analysis of the 10,000 pregnant patients delivered at the Gorgas Hospital in the Panama Canal Zone between 1931 and 1945. The records of the Gorgas Hospital afford an unusual opportunity to evaluate the influence of race, economic conditions, and a tropical climate on pregnancies under good prenatal care.

Three distinct groups of peoples populate the Canal Zone. There are the Panamanians, who are divided into the silver and the gold groups. The silver group is composed of the West Indian negroes and Panamanians whose income is limited by low fixed standards; their housing is crowded, families are large and life for them is a continuous economic struggle. The gold patients are Panamanians who are employed by the government and have a standard of living comparable to the Americans. The third group are the white Americans who have migrated to this area.

There has been a marked increase in the incidence of eclampsia in the Canal Zone during this period. This increase is a real one and is not due to changed standards of medical diagnosis. It is common to all the groups of people. No significant seasonal variations could be found.

There is a markedly higher incidence of eclampsia in negroes in Panama which cannot be adequately accounted for by racial dietary therapeutic or climatic factors. It is believed that adverse social and psychological factors affecting the negroes to a greater degree than the other population groups may be an important influence. *JOHN R. WOLFE M.D.*

Further Observations on the Use of the Neutral Diet and Hydration in the Treatment of Toxemias of Late Pregnancy *RUSSELL R. DE ALVARADO M. J. Obst. 1947 54 445*

Patients with toxemia in late pregnancy are generally best managed in a conservative fashion. The essentials of this conservative management consist of hospitalization bed rest hydration neutral diet and ammonium chloride. The object of treatment is to return the involved tissues and organs to and to maintain them in, as nearly a physiologic capacity as possible. The management of these patients is designed to treat the toxic manifestations already demonstrated and prevent additional ones.

It is imperative that treatment be instituted early in order to prevent progression of seemingly insignificant findings as well as to forestall latent sequelae. Bed rest and hospitalization are essential preliminaries for treatment. The neutral diet consists of foods which yield an equal amount of acid and alkaline ash to which are added certain foods which yield an ash with no chemical reaction. The term "neutral diet" implies that the diet is salt free and sodium poor. The average diet contains about 2,000 calories daily. The protein content is maintained at from 85 to 100 gm. daily. Fluids are forced to a level sufficiently high to produce urinary excretion approximately equal to that of a normal individual. Fluids are supplied by mouth parenterally or by both routes if necessary in order to insure a minimum daily urinary output of 2,000 c.c. Frequently a daily minimum fluid intake of 4,000 c.c. is necessary to obtain a normal water balance. Ammonium chloride is administered to release the sodium ion from the tissues and to release the intercellular fluid retained by the sodium. It is given in gelatin capsules in order to insure complete absorption. The average dose is 45 gr. 3 times daily which is continued for 4 days. Sedation is used when needed.

When conservative methods fail to control pregnancy toxemia termination of the pregnancy is effected by the most conservative means suited to the particular individual. The indications for cesarean section in toxemia patients should be essentially the same as in patients without toxemia.

JOHN R. WOLFE M.D.

Chronic Hypertension and Pregnancy *F. J. BAOWKZ. Brit. M. J. 1947 53.*

Of all cases of toxemia of pregnancy 15 per cent occur in women who before pregnancy begin are the subject of chronic hypertensive vascular disease. These cases are differentiated from the much more common pre-eclamptic toxemias (70% of toxemias)

and the much rarer chronic glomerular nephritis in pregnancy (5%).

The standard of normal blood pressure is taken by the author to be 120/80, although other authorities have taken as normal an upper limit of 140/90. As a rule blood pressure in normal pregnancies is lower than in the nonpregnant adult particularly the diastolic pressure and there is a greater pulse pressure. Other considerations of blood pressure are that (1) it does not rise with age in normal persons but does in the potentially hypertensive (2) a 10 year elevation of blood pressure above 120/80 is pathological (3) transient rises in the blood pressure should be ignored (4) 40 per cent of the population of the United States is actually potentially hypertensive.

In separating patients in the chronic hypertensive group from those in the pre-eclamptic group, the author places in the former group those patients in whom hypertension is discovered before the twentieth week of gestation and in the latter those who are found to have hypertension after the 20 week border line. He notes a definite familial tendency of hypertension in the former group not in the latter. Clinically the woman with chronic hypertension is somewhat older than normal (average age 30.3 years) she feels well and has no edema albuminuria, or impaired renal function her previous pregnancy has generally ended in stillbirth or abortion. During the second 3 months of gestation her blood pressure falls in a certain number of cases (40% in the author's series) a fact important in differentiating this condition from pre-eclamptic toxemia. However the pressure rises again during the last 3 months, generally at the twenty-fifth week or later (54% of cases) but the mechanism of this last rise is not understood.

Clinical experience shows that when the blood pressure reaches 160 mm. systolic, albumin usually appears in the urine and the fetus is apt to die in utero (17.5%). The albuminuria is not itself the cause of fetal death, nor is there a renal toxin involved rather it is thought that both the albuminuria and fetal death are due to the same cause, i.e. vascular spasm which causes albuminuria in the kidney and anoxia and injury to the vessel walls of the uterus and terminates in concealed hemorrhage.

Pregnancy should be terminated early if renal function studies show decided deficiency or if there is definite retinal arteriosclerosis, exudates, papilledema or if there is persistent albuminuria even with albuminuria alone which is noted before the twentieth week, intrauterine death is almost inevitable. The patient's reaction to rest is a guide to the continuation of pregnancy—if her pressure remains at 150/100 or over the outlook toward a favorable outcome is doubtful but should it fall one may be optimistic. Every clinical therapeutic effort should be made to keep the blood pressure below the critical level of 160 mm. systolic, and this is accomplished by bed rest in the hospital and sedation. The use of potassium thiocyanate is suggested for the high levels but its results have not been satisfactory according to the author. The author emphasizes, how

ever that papilledema with or without retinal exudates is a primary indication for therapeutic abortion.

A natural delivery may be allowed if there is no serious exacerbation or if pre-eclamptic toxemia does not appear. If intervention is to be carried out it is well to wait until about the thirty-seventh week (counted from the first day of the last menstrual period) when the fetus is viable and has a better chance of survival than if it is left in the uterus until term. Although cesarean section should generally be employed in cases of prematurity induction and birth through the natural passages has its place in handling these cases.

The outlook for the child bears a definite relation to the height of the blood pressure at the start of pregnancy, the fetal mortality is around 60 per cent when the blood pressure is over 150/100 in the mother. However if the blood pressure falls during the second trimester there is an excellent chance that a healthy child will be born at term.

Pregnancies exert no lasting deleterious effect on the patient with hypertension although there is a much greater risk that eclampsia or pre-eclamptic toxemia may develop in the hypertensive patient. Although the patient does not actually benefit from pregnancy pregnancy is not injurious provided the patient survives the immediate risks of the parturient nor does pregnancy seem to cause any permanent aggravation of hypertension.

Comparative statistics by the author show that there is no significant difference between blood pressures in nulliparous and parous women in any age group. In fact, neither pre-eclamptic toxemia nor eclampsia per se cause chronic hypertension or bring out a latent hypertension earlier than it otherwise would have appeared.

PHILIP B. CHASE, M.D.

Pollomyelitis in Pregnancy. ANTERO SETÄLÄ. *Ann. Chir. Gyn. Fenn.* 1947 36 117

The author reviews the Scandinavian literature on acute pollomyelitis in pregnancy and lists 87 cases. He adds 15 of his own from Finland and notes that the incidence of pollomyelitis has increased in the older age groups. Pollomyelitis was found to be more prevalent among males than among females, but there were more women aged 20 to 40 than men among the reported cases for the entire country.

The expected incidence of pollomyelitis in pregnancy in the city of Helsinki based on the birth rate and the total number of cases is calculated and the figures would predict an incidence of from 2 to 3 cases. Actually 6 cases were discovered. A survey of the other reported cases based on similar statistics revealed that the actual incidence was three times that which was expected.

The pooled statistics indicated that most women with pollomyelitis in pregnancy suffered from the type that is associated with paresis. No difference could be observed in predisposition to the disease in the different stages of pregnancy. The prognosis was variable with the different authors reporting

and of 61 cases in which the prognosis was discussed there were 14 maternal deaths. In Setälä's series of 15 cases there were 5 deaths 4 of these occurring in the latter half of pregnancy.

Because of the small number of cases, no definite conclusions could be reached as to the course of labor and the delivery but it seemed to the author that the duration of the first stage of labor was not prolonged, and that only in patients with paresis of the abdominal muscles was the second stage prolonged beyond the usual expected duration. Post partum hemorrhage did not occur in any of the cases in this series.

The intrauterine development of the babies appeared to be normal and although the question as to whether the fetus can contract the disease in its intrauterine life is undecided none of the babies had symptoms at birth, nor did they show evidence of it in the cases which were followed.

GEORGE B. BRADBURN, M.D.

Pregnancy Complicating Tuberculosis. C. J. BARON, J. A. FIDIO and L. H. HETHERINGTON. *Am. J. Obst.*, 1947 54 475

The incidence of tuberculosis complicated by pregnancy at the Elizabeth Steel Magee Hospital Pittsburgh Pennsylvania is 0.35 per cent. A review of 62 cases of tuberculous patients followed for a 5 to 15 year period is presented.

Of these 62 patients 33.8 per cent are now dead and of the latter 30.6 per cent died of tuberculosis.

Of those in whom the pregnancy was interrupted by abortion within the first 3 months, 38 per cent are now dead.

Of the 62 patients 61.5 per cent had moderately advanced or far advanced tuberculosis and 44.8 per cent of the latter are now dead. All types of delivery including therapeutic abortion were used. Of the patients subjected to cesarean section in order to terminate the pregnancy 36.3 per cent are now dead of tuberculosis. The mortality for the patients who had spontaneous deliveries was 19.8 per cent.

The best results in this survey were obtained in those patients who delivered spontaneously regard less of the extent of the tuberculosis.

JOHN R. WOLFF, M.D.

LABOR AND ITS COMPLICATIONS

Elective Induction of Labor. R. M. GRIER. *Am. J. Obst.* 1947 54 511

The elective induction of labor has long been a subject of much controversy. Some regard it as needless and vicious. Others state that the membranes may be ruptured with impunity. In the past 10 years labor has been induced by choice in 1,353 or 12.9 per cent, of the women delivered at the Evanston Hospital Evanston Illinois.

The precipitation of imminent labor by rupture of the membranes can be very successful. The proper selection of cases is most important. The criteria for this proper selection are (1) there should be no

There is a markedly higher incidence of eclampsia in negroes in Panama which cannot be as adequately accounted for by racial dietary therapeutic or climatic factors. It is believed that adverse social and psychological factors affecting the negroes to a greater degree than the other population groups may be an important influence. JOHN R. WOLFF MD

Further Observations on the Use of the Neutral Diet and Hydration in the Treatment of Toxemias of Late Pregnancy RUSSELL R. DE ALVARES
Am J Obst 1947 54 445

Patients with toxemia in late pregnancy are generally best managed in a conservative fashion. The essentials of this conservative management consist of hospitalization, bed rest, hydration, neutral diet, and ammonium chloride. The object of treatment is to return the involved tissues and organs to and to maintain them in as nearly a physiologic capacity as possible. The management of these patients is designed to treat the toxic manifestations already demonstrated and prevent additional ones.

It is imperative that treatment be instituted early in order to prevent progression of seemingly insignificant findings as well as to forestall latent sequelae. Bed rest and hospitalization are essential preliminaries for treatment. The neutral diet consists of foods which yield an equal amount of acid and alkaline to which are added certain foods which yield an ash with no chemical reaction. The term "neutral diet" implies that the diet is salt free and sodium poor. The average diet contains about 2,500 calories daily. The protein content is maintained at from 85 to 100 gm daily. Fluids are forced to a level sufficiently high to produce urinary excretion approximately equal to that of a normal individual. Fluids are supplied by mouth, parenterally or by both routes if necessary in order to insure a minimum daily urinary output of 2,000 c.c. Frequently a daily minimum fluid intake of 4,000 c.c. is necessary to obtain a normal water balance. Ammonium chloride is administered to release the sodium ion from the tissues and to release the intercellular fluid retained by the sodium. It is given in gelatin capsules in order to insure complete absorption. The average dose is 45 gr 3 times daily which is continued for 4 days. Sedation is used when needed.

When conservative methods fail to control pregnancy toxemia, termination of the pregnancy is effected by the most conservative means suited to the particular individual. The indications for cesarean section in toxemia patients should be essentially the same as in patients without toxemia.

JOHN R. WOLFF MD

Chronic Hypertension and Pregnancy F. J. BAOWE
Brit. M J 1947 283.

Of all cases of toxemia of pregnancy 25 per cent occur in women who before pregnancy begin are the subject of chronic hypertensive vascular disease. These cases are differentiated from the much more common pre-eclamptic toxemias (70% of toxemias)

and the much rarer chronic glomerular nephritis in pregnancy (5%).

The standard of normal blood pressure taken by the author to be 120/80 although other authorities have taken as normal an upper limit of 140/90. As a rule, blood pressure in normal pregnancies is lower than in the nonpregnant adult, particularly the diastolic pressure and there is a greater pulse pressure. Other considerations of blood pressure are that (1) it does not rise with age in normal persons but does in the potentially hypertensive (2) a 10 year elevation of blood pressure above 120/80 is pathological (3) transient rises in the blood pressure should be ignored (4) 40 per cent of the population of the United States is actually potentially hypertensive.

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The pooled statistics indicated that most women with poliomyelitis in pregnancy suffered from the type that is associated with paresis. No difference could be observed in predisposition to the disease in the different stages of pregnancy. The prognosis was variable with the different authors reporting

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JOHN R. WOLFF, M.D.

LABOR AND ITS COMPLICATIONS

Elective Induction of Labor R. M. GRIER. *Am. J. Obst.* 1947 54 511

The elective induction of labor has long been a subject of much controversy. Some regard it as middlesome and vicious. Others state that the membranes may be ruptured with impunity. In the past 10 years labor has been induced by choice in 1,353 or 12.9 per cent of the women delivered at the Evanston Hospital Evanston, Illinois.

The precipitation of imminent labor by rupture of the membranes can be very successful. The proper selection of cases is most important. The criteria for this proper selection are (1) there should be no

cephalopelvic disproportion (2) the baby should be mature and preferably present by the vertex (3) the fetal head should be engaged or dipping well into the pelvis, (4) the cervix should be soft partially effaced and dilated to at least 1 cm.

The use of a dressing forceps rather than a sharp pointed perforator and its guidance through the vagina with a gloved finger in the rectum is the recommended method of rupturing the membranes to induce labor. The use of quinine and castor oil is potentially harmful often inefficient and certainly unpleasant. Calcium gluconate given intravenously has seemed to be a definite aid in producing normal and efficient uterine contractions. Pituitrin in more than 1 minim doses is not necessary. The usual technique of induction is to give a hot soapsuds enema followed by 10 c.c. of 10 per cent calcium gluconate solution given intravenously. Within 2 hours the membranes are ruptured artificially as described. If labor does not ensue within 2 hours pituitrin in 1 minim dosage is given intramuscularly at from 30 to 60 minute intervals. Usually no more than 2 doses are required.

There was no mortality in these cases and the maternal morbidity was less than the general average for the past 10 years. The gross fetal mortality was less than 2 per cent which is less than the general fetal mortality for the past 10 years. A physician is justified in making labor easier for his patient provided he can accomplish it safely. The results here presented show that the elective induction of labor in properly selected cases or in other words, the precipitation of imminent labor is a justifiable procedure.

JOHN R. WOLFE, M.D.

Induction of Labor at the Chicago Lying In Hospital. WM. J. DIECKMANN and R. EST. B. McCREADY. *Am J Obst.* 1947 54 495.

When the termination of pregnancy is indicated after 32 weeks, the doctor must choose either cesarean section or the induction of labor. The latter would be completed preferably by vaginal delivery and rarely by cesarean section. Induction of labor is indicated in comparatively few cases as compared with 25 or more years ago when the cesarean section mortality was 10 per cent or more.

The primary consideration must always be: Is the patient better off with the uterus empty? or if the infant is alive and in good condition are its chances of survival increased by early delivery? The indications for the induction of labor are selected cases of placenta previa, abruptio placenta, eclampsia and nonconvulsive toxemia of pregnancy. The induction of labor for postmaturity, contracted pelvis or the convenience of either the patient or doctor is contra-indicated. In the hemorrhagic groups the patient should be delivered vaginally if she possibly can be without undue hemorrhage. In the patients with toxemia one must evaluate the condition of the cervix and severity of the toxemia. If the latter permits delay the cervix will change and permit relatively safe induction of labor.

Rupture of the membranes is the simplest and easiest means of inducing labor. Castor oil and quinine have no place in this technique. A vaginal examination with sterile technique should precede all attempts at induction. A careful evaluation of the pelvis, the determination of the presenting part, and the exclusion of a concealed prolapse of the cord, as well as the condition of the cervix must be determined. If the cervix is "ripe" labor can be successfully induced and delivery completed within 24 hours in more than 80 per cent of the patients. The incidence of attempted induction of labor at the Chicago Lying In Hospital, Chicago is 3.3 per cent, with a failure of induction in 9 per cent.

The induction of labor is inevitably followed by an increased maternal and fetal morbidity and mortality irrespective of how carefully the cases are selected.

JOHN R. WOLFE, M.D.

The Management of Prolonged Labor. HERBERT E. SCHWITZ, JAM. A. N. B. EWING, JAMES E. TOWNE, and GROSCE R. HARR. *Am J Obst.* 1947 54 615.

One of the most trying complications of pregnancy confronting the obstetrician is the management of prolonged labor. In this investigation 24 hours has been selected as the limit beyond which the labor is considered prolonged. Labor was considered to be initiated with the onset of regular uterine contractions associated with pain regardless of the presence or absence of effacement, dilatation of the cervical os or rupture of the membranes.

In the 4 year period between July 1, 1942 and June 30, 1946 5,509 patients were delivered at the Lewis Memorial Maternity Hospital, Chicago. Of these, 224 (4.0%) patients had labor exceeding 24 hours duration. The cases excluded obstructed labor due to complicating tumor or disproportion and were confined to those in which normal progress was expected but did not materialize. The authors believe that presentation and position do not materially influence the first stage of labor in the majority of the cases. They do however play a more important part in the second stage and its management hence, the cases of brow, breech and transverse presentations are included.

The routine procedure of management is based on extreme conservative care directed toward anticipating and combating infection and exhaustion during the antepartum phase and maintaining a constant vigil for hemorrhage and shock during the postpartum phase.

As it is an established fact that the incidence of infection is increased as the duration of labor is lengthened particularly after the rupture of the membranes rectal and vaginal examinations are kept to a minimum. Every effort is made to avoid vulval contamination during rectal examination and all vaginal examinations are made in the delivery room under strict aseptic technique.

Dehydration, starvation, and exhaustion are combated by the early institution of a dietary regime which includes small feedings of a soft diet every 4

hours. Liquid intake by mouth is encouraged. In the event that the patient is unable to retain food or liquid by mouth 1,000 c.c. of a 5 per cent glucose in saline solution is administered twice a day or oftener if indicated. Exhaustion is combated by an 8 hour period of rest alternating with a like period of labor. Morphine sulfate was the drug of choice in these cases as the barbiturates not infrequently caused excitation in the patient.

When labor has been in progress for 24 hours the urine is examined every 6 hours for acetone and albumin and the fluid output checked carefully. In the event of the appearance of acetone and diacetic acid in the urine, with a rising pulse rate and signs of impending collapse, the patient is heavily sedated and placed on continuous fluids.

During the period following the sedation the labor usually progresses without stimulation. In a few instances in this series intravenous calcium gluconate, quinine and rarely small doses of pituitrin were used.

Delivery is not attempted in any case until the first stage is terminated and the cervix completely dilated. Major operative procedures are discouraged during the second stage unless the conditions and indications warrant interference.

Following delivery the patient is kept in the delivery room under sterile drapes for a period of an hour. The blood pressure is checked every 15 minutes or oftener if indicated. Early use of plasma and whole blood are encouraged. Intrauterine packs are used to control hemorrhage when needed, but such a procedure tends to increase the danger of infection.

The prolongation of labor is usually due to the prolonged first stage. The duration of the first stage is dependent on two main factors: (1) resistance of the cervix to dilatation and (2) the all important intensity and frequency of the labor pain. Prolonged labor caused by cervical dystocia is usually due to congenital anomaly, severe scarring from previous trauma or long standing infections with resulting fibrosis or scarring. In the authors series, however there was no instance in which cervical incision was considered to be indicated.

A definite increase of fetal mortality in prolonged labor as well as increased maternal morbidity was noted. There were no maternal mortalities. The elderly primipara group showed a higher percentage of prolonged labor than the younger group. It also showed a marked increase in the fetal mortality.

JOHN R. WOLFF, M.D.

Physiologic Changes in the Circulation during and after Obstetric Labor. ELLIS BROWN, JOHN J. SAMSON, EDWIN O. WHEELER, BENJAMIN F. GUNDELKOR, and JOSEPH E. GIANTRACUSA. *Am Heart J.*, 1947, 34, 311.

By means of various determinations of circulatory function the authors seek to ascertain the effects of emptying the uterus, either by labor or cesarean section. That the work of labor is not alone the cause of cardiac stress is evident from the fact that deaths

from congestive failure occur with as great frequency following cesarean section as after vaginal delivery. Because of the possibility that the pregnant uterus may function as an arteriovenous fistula, of significant proportions, acute changes were sought that might indicate occlusion of such a fistula by delivery itself.

Serial observations both intrapartum and postpartum, of changes in heart rate, arterial blood pressure, vital capacity, venous pressure, hematocrit values and plasma volume (using T 1824) were carried out on a total of 24 patients. These included patients both with and without cardiac disease, and patients delivered vaginally and by cesarean section without a trial of labor. Only the results of the last three mentioned studies were sufficiently uniform to lead to definite conclusions.

On the basis of the shunt hypothesis, a rise in venous pressure would be expected postpartum. Contributing causes however may consist of increased blood return from exercise and blood expressed from the uterus by oxytocic drugs. The increase in venous pressure was less marked following vaginal delivery than after cesarean section. It is postulated that during the uterine contractions of labor intermittent increases of venous pressure produce filtration of fluid from the capillaries and therefore a gradual reduction of blood volume. To minimize the effects of increased venous pressure it is recommended that oxytocics be used cautiously in heart disease especially in the presence of congenital intracardiac shunts.

Hematocrit and plasma volume estimations agreed with previous observations that (a) with delivery a significant quantity of fluid leaves the blood stream, (b) a volume equal or greater to this re-enters the vascular compartment on the second day of the puerperium or later, and (c) probably through diuresis the blood volume returns gradually to normal.

The authors conclude that though not conclusive, their findings at least suggest that delivery of the fetus either by vaginal or cesarean delivery produces effects resembling those following obliteration of a large arteriovenous shunt.

WARREN R. LANG, M.D.

Shock in Obstetrics. W. A. SCOTT. *Brit M J*, 1947, 2, 647.

The author states that the mechanism of surgical shock is as yet unknown, but clinically he has observed a group of cases characterized by hypotension, decreased blood volume, decreased cardiac output, and hemoconcentration which present a common clinical picture regardless of etiology. It is emphasized that these patients present a group of symptoms and not a disease, and that prevention and treatment are of primary importance.

The author states that in the urban centers there has been a great reduction in the number of maternal deaths due to shock in the past 25 years. The great majority of cases of obstetric shock can be attributed to hemorrhage. This was shown quite conclusively by

an analysis of the maternal deaths in the Province of Ontario, Canada, for 1943.

A review of 12,749 deliveries at Toronto General Hospital, Toronto, revealed 109 cases of postpartum hemorrhage with 6 deaths. The mortalities occurred in the patients with a blood loss of 1,000 c.c. or over and death ensued within a period of 63½ hours from the time of birth. It is stated that most of these fatalities were due to errors in judgment.

The predisposing factors to the development of obstetrical shock are excessive blood loss, labile vasomotor system, increased capillary permeability and trauma. This is manifested clinically in the following obstetrical emergencies: postpartum hemorrhage, rupture of the uterus and eclamptic toxemia.

The author states that the treatment of obstetrical shock is prophylaxis. Any pre-existing predisposing factors should be corrected upon recognition.

The active treatment of shock consists of immediate and complete relief of pain, maintenance of body heat and the replacement of circulating blood volume by whole blood if possible, otherwise the use of plasma or glucose solution is indicated; the bleeding should be controlled at its source. If surgery is indicated, it should be performed only after the shock has been corrected. J. ROSE & WILLIAM M.D.

PUERPERIUM AND ITS COMPLICATIONS

The Placental Stage and Postpartum Hemorrhage. Wm. J. DIECKMANN, LECTURER D. O. BELL, VICTOR M. WILLIAMS, A. THOMAS G. SEVER, and RUSSELL PORTINGER. *Am J Obst* 1947 54: 43.

Even in this age of atomic energy, women still die of hemorrhage associated with parturition. Hemorrhage caused 50 per cent of the maternal deaths which occurred in the United States in 1944 and 1945. These deaths were either preventable or they occurred as the result of preventable factors. A marked reduction in the incidence of postpartum hemorrhage due to uterine atony will follow the proper conduct of the late second and early third stages of labor. The importance of a definite routine for the prevention and treatment of postpartum hemorrhage is stressed.

The prevention of postpartum hemorrhage is much easier than its treatment. Prevention begins with the proper conduct of the terminal phase of the second stage of labor. For a proper separation of placenta, it is of utmost importance that the baby be delivered slowly—in stages with a 30 to 60 seconds pause after the delivery of each shoulder—which requires a total of at least 3 minutes. Thus, the uterine wall is given time to contract and retract thereby tearing itself away from the placenta; the latter has usually separated within less than 1 minute. After the fetus has been expelled, as soon as the uterus retains its globular form it should be compressed but not pushed into the pelvis. When the placenta is in the vagina it should be extracted by pulling on the cord. Although an oxytocic is not necessary for the

separation of the placenta under normal conditions, with patients under analgesia and anesthesia, one unit of a solution of posterior pituitary or 0.2 to 0.4 mgm. ergotrate should be injected intravenously after delivery of the posterior shoulder, if the doctor is experienced. If he is not, then after the delivery of the placenta. This will prevent excessive bleeding after the placenta.

If the placenta cannot be delivered and there is no bleeding, one may wait a maximum of 1 hour but all retained placenta should be manually removed at the end of this time.

Uterine hemorrhage is treated by the immediate removal of the placenta manually if necessary or after the third stage by manual palpation of the uterine cavity and visual inspection of the vagina and cervix. One of the oxytocics mentioned above should be injected intravenously and repeated one time. If the bleeding continues, the uterus must be packed. A transfusion of 1,000 c.c. or more of blood, if necessary, must be given at once. Periodic hemoglobin or hematocrit determinations must be made. J. ROSE & WILLIAM M.D.

NEWBORN

New Methods in the Treatment of Asphyxia of the Newborn (Neue Methoden in der Behandlung asphyktischer Neugeborenen). R. BICKENBACH. *Arch med Klin* 1947 71: 434.

In order to overcome the anoxia of the respiratory center it is important to supply the newborn with as much oxygenated blood as possible. The placenta represents a reservoir of oxygenated blood and it has been shown that under normal conditions, 51 per cent of the blood in the placenta flows through the cord within the first minute after birth. This amount and the rate of flow can be increased to 76 per cent and 30 seconds, respectively, by utilization of the force of gravity and by manual expression of the cord.

Immediately after birth the newborn is grasped by the feet and is held head downward, as far below the level of the placenta as the length of the cord will permit. By this method of antegrade transfusion the blood volume of the newborn is increased by about 75 c.c., i.e., approximately one fourth of the total blood volume. In the majority of cases this technique alone is sufficient to start the respiration. The author was able to show that the hydrostatic pressure in the umbilical cord is increased considerably by this procedure.

In addition to this mechanical method, coramine or other analeptics may be injected into the umbilical vein about 10 cm. distal from the umbilicus. This should be done within 30 seconds after delivery because the circulation stops in most cases about 1 minute after birth.

The usual methods of artificial respiration are often unsatisfactory in asphyxia of the newborn because the lungs are atelectatic and the thorax is in the position of extreme expiration. Better results are

achieved by using the resuscitator which permits expansion of the lungs under positive pressure. To stimulate the respiratory center, from 3 to 6 per cent of carbon dioxide should be added to the oxygen.

WERNER M. SOLMITZ, M.D.

MISCELLANEOUS

Relationship between Erythrocyte Sedimentation Rate, Sludged Blood, and Plasma Proteins during Pregnancy LESTER D. ONELL, GLORIA T. ARAGON, and RUSSELL E. POTTINGER. *Am. J. Obst.* 1947 54: 596

The purposes of this article are (1) to report the presence of "sludged blood" in women during both normal uncomplicated pregnancy and during pathologic pregnancies (2) to report that the masses of agglutinated red cells are larger in certain of the pathologic conditions examined than in the uncomplicated pregnancies (3) to point out probable relationships between (a) the intravascular agglutinations of the blood, (b) the increased in vitro sedimentation rates of blood from these patients and (c) changes in the concentrations of certain plasma protein fractions.

It is stressed that rouleaux formation differs, by definition from an intravascular agglutination of cells (or sludge). The former consists of an in vitro piling up of red cells like coins, one on another; the latter of in vivo intravascular cell aggregates where-in erythrocytes are held together at all angles to each other. The authors suggest that both phenomena relate to an increased cellular cohesiveness and the nature of the substance causing this should become an object for much research.

A total of 52 pregnant and nonpregnant subjects were selected for study. These included 31 whose pregnancy was normal and 23 whose pregnancy was complicated: 16 with toxemia, 4 with thrombophlebitis and infection, 2 with acute hemorrhagic shock and 1 with ectopic pregnancy. Nonpregnant controls numbered 8.

The lateral bulbar conjunctiva was viewed with a Zeiss dissecting microscope. The size of intravascular masses and the degree in reduction of rate of flow were evaluated in fine, medium and large venules and in arterioles. Sedimentation rates were estimated on the basis of these direct microscopic observations and were measured in vitro. Fibrinogen and total serum proteins were determined on the interferometer. Albumin and globulin fractionation was obtained.

Observations by microscopy numbered 103. 77 of these are tabulated with simultaneously obtained sedimentation rates and plasma protein values.

Nonpregnant controls. In none of 6 female subjects studied whose sedimentation rates were below 24 mm./hr. was any intravascular agglutination of the blood observed. In 2 patients, whose diagnoses were pelvic inflammatory disease and generalized carcinomatosis there were large easily observable agglutinations within the venules and arterioles. a

reduced rate of blood flow and in some vessels a temporary cessation of the flow as anticipated the sedimentation rates were high.

Normal pregnancy. Sludged blood, consisting of intravascular agglutinations of erythrocytes and reduced rates of flow with temporary cessation of flow in some vessels, was observed in all subjects with sedimentation rates of 33 mm./hr. or more. The largest cell masses and the greatest reduction in flow were seen in the patients who were near term in labor or early in the puerperium.

Pathologic pregnancy. In toxemia of pregnancy a noticeable narrowing of the arterioles could be detected in most of the patients. These vessels were not affected in normal pregnancy. In addition, intravascular agglutinations and reduced flow rates were observed. The sizes of masses comprising the sludge were larger the rate of flow was considerably more decreased and cessation of the flow was more prolonged as compared with normal pregnancy.

Thrombophlebitis and infection. Identical evidences of sludged blood were seen. The sedimentation rates were unusually high in these patients.

Hemorrhagic shock. Three instances of severe hemorrhagic shock were observed in the same patient. Evidence of sludged blood appeared and was relieved by blood replacement therapy. Intravascular agglutinations were again noted after operative procedures with their attendant trauma. Thus appearance of sludged blood in the experimental animal has been noted.

Sedimentation rate. Conjunctival observations closely approximated the measured, uncorrected hourly values. Values were higher at term in labor or during the puerperium and highest in infections. In addition the sedimentation rates of patients with pregnancy toxemia tended to be higher than those of women with normal pregnancy. There was close correlation with plasma fibrinogen values, less with albumin, globulin, or the albumin-globulin ratio and no relationship with total serum proteins.

JOHN R. WOLFF, M.D.

Fetal and Maternal Mortality N. S. ASHALL and L. F. ZACHARIAS. *Am. J. Obst.* 1947 54: 651

This article represents a compilation of the data collected in a survey covering an 11 year period from January 1935 through December 1945, at the Department of Obstetrics, Bethesda Hospital, Cincinnati, Ohio. The 11 years are considered in two periods, the first from 1935 to 1940 and the second from 1940 to 1945.

Deliveries by general practitioners predominated in the first period. This period was also characterized by abuse of cesarean section, the use of high forceps and lack of control of the obstetric procedures. In consequence, a high fetal and maternal death rate was noted.

Although obstetricians continued to deliver a relatively small proportion of the patients at the outset of the second period significant modifications in pol-

icy occurred. Rigid rules were established by the Obstetrical Committee regarding the performance of cesarean section and the use of the high forceps. Frequent utilization of obstetric consultants was required and supervision of the delivery was instituted. These changes brought about definite improvement in standards of practice with consequent decrease in maternal and fetal mortality. The improvement has been increasingly evident in the latter years of this period.

In the hands of the obstetric staff breech delivery has received particular attention in recent years. Increasing emphasis on external version and careful roentgenologic study in cases of breech presentation have made possible accurate determination of cephalopelvic disproportion with consequent reduction in the number of unnecessary cesarean sections. In addition the use of the bag for dilatation of the cervix and routine episiotomy have made breech delivery less traumatizing.

Despite the continued efforts of obstetricians and pediatricians little has as yet been accomplished in the reduction of mortality attributable to prematurity. It is the authors' hope that by the more extensive employment of the procedures and principles noted concerning breech delivery plus more circum-

spect use of maternal sedation, constant use of pediatric consultation and improved management of toxemia the mortality among premature infants will be reduced.

Fifteen thousand and eighty-eight deliveries occurred during the 11 years of this report. For the entire period the gross fetal mortality was 4.5 per cent, and the corrected mortality 3.5 per cent. Although the results have been improved in the more recent years these figures still remain high.

Breech and version delivery resulted in the highest and low forceps delivery in the lowest fetal mortality rate.

The fetal and maternal mortality among deliveries by general practitioners was higher than that of obstetricians.

Prematurity was the major fetal contributing factor and toxemia the major maternal factor causing fetal death.

The gross maternal mortality was 0.18 per cent and the corrected 0.17 per cent. It has steadily decreased throughout the past few years during which time it has ranged between 0.10 and 0.13 per cent.

Hemorrhage and shock, infection, toxemia, and heart disease were the major causes of maternal death.

JOHN R. WOLFE, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

The Suprarenal Cortical Syndrome WILLIAM L. MCLACHLIN, JON P. BOWLER and JARRETT H. FOLLEY, J. C. Balt. 1917 58 221

The suprarenal cortical syndrome is defined as the sum of metabolic changes produced in the body by the presence of an excessive amount of a renal cortical steroids. This excess of steroids may be the result of hyperplasia of the adrenal cortex brought about by the adrenotropic hormone of the pituitary gland or a primary tumor of the adrenal cortex.

The authors presented a patient with a clinical picture of suprarenal cortical syndrome that was produced by carcinoma of the right adrenal gland. Following the extirpation of this neoplasm the patient developed a state of adrenal insufficiency which resulted in a slow but complete recovery. Without identifying the type or types of excess steroid the authors stated that their patient's adrenal cortical neoplasm produced steroids of considerable biologic activity. ROBERT THRELL, M.D.

Ureteral Transplantation and Cystectomy VICTOR F. MAXWELL, J. Urol., Balt. 1947 58 244

Transplantation of the ureters and total cystectomy is a surgical procedure of considerable magnitude which carries a postoperative mortality of at least from 10 to 20 per cent. Radiation therapy for bladder cancer carries a much lower immediate mortality so that before advising the surgical program the surgeon should have some definite reasons in mind.

First of all, how effective is radiation in the treatment of bladder cancer? Three hundred consecutive bladder cancer records at the Memorial and New York Hospitals from 1932 to 1938 inclusive were reviewed in detail. Papilloma was excluded and it must be stressed that the pathologists' criteria were very strict excluding from the cancer classically even atypical papillomas which are commonly considered of low grade malignancy. Only 53 patients or 1 per cent were known to have survived 5 years and only 27 (50%) of these could be called 17 patients representing 5 year successful results. These will not all stand as cured upon critical review as at least 5 created some doubt in regard to the diagnosis of cancer at least 5 were in poor condition at the 5 year anniversary and at least 5 died subsequently without a reliable record of the cause of death being obtained. Furthermore 3 were clinically free of disease because cystectomy had been deferred after the failure of radiation therapy. All points considered, it would be reasonable to say that by the author's radiation method 14 of the 1010 at the 5 year successful result rate was approximately 6 per cent. The average survival was 34.5 months for a group of 316 patients who were treated with a 5 year follow-up.

This hardly compares favorably with results of non-treatment as reported elsewhere in which the average survival was 18.8 months and approximately 20 per cent of the patients survived 5 years.

The simplest surgical treatment of bladder tumors is local destruction by fulguration. On review of the author's old and recent records very few good results were obtained by this method and the overwhelming majority of tumors proved to be no more than papillomas histologically and not cancer especially when the result was not obviously a failure. Most of the few good results were obtained when small well localized and low grade lesions were present but there were so many apparently similar cases which resulted disastrously that the criterion for choosing candidates was not evident. Few interstitial cancers are cured by simple local destruction and a complete follow-up on histologically proved bladder cancer indicates no major exception in the author's experience.

Thirty three bladder resections done within the past 5 years have resulted already in 11 known recurrences in the bladder and 3 postoperative deaths. Twelve of the 33 patients are now known to be dead. Even so the average survival was 20 months in spite of the fact that the follow-up was 2 years in 17. Several patients have had excellent results thus far but the impression is unavoidable that in the anxiety to preserve bladder function and avoid more immediately hazardous surgical procedures resection was done on lesions which were too large on lesions in which the margin of removal was multiply within the bladder.

Total excision of the bladder is usually not a difficult or dangerous operation in itself as was shown by the occurrence of only 2 deaths in more than 100 cases a mortality of 2 per cent or 1. However the real surgical problem is the safe and permanent diversion of the urinary stream prerequisite to cystectomy. Transplantation of the ureters to the skin is a relatively simple procedure and in the author's experience almost all postoperative deaths could be obviously attributed to the poor preoperative condition. Structure and access formation is associated with incontinence if my catheters become more common the larger the follow-up is continued. Occasionally calculi have seemed better than catheters with uterine catheters complications but only a few patients can manage them. At least the patient can wear a cumbersome but functional apparatus at least it is unobjectionable. If the ureters are transplanted to the bowel above a normal anal sphincter the patient does not need an apparatus which is socially acceptable.

and, except for the necessity of sitting to urinate which half the population does naturally appears outwardly normal. However the problem is not simple because the immediate and late risks of ureterointestinal anastomosis are not only greater but are usually of more grave importance after skin transplantation.

The author transplanted the ureters to the bowel in 304 patients by the Colley I intraperitoneal method. Thirteen deaths resulted a mortality of 12.5 per cent. Two patients died of peritonitis from leakage and 1 from small intestinal obstruction at the operative site. This 2.8 per cent represents the only postoperative mortality due to complications in the peritoneum the urinary tract or the gastrointestinal tract. Of the remaining 10 deaths, 3 were due to congestive cardiac failure 3 to embolism 3 to carcinomatosis, and 1 to the effects of a radical operation on a recurrent urethral carcinoma. The author emphasizes the fact that this series includes palliative cases and that only 8 patients had transplantation for conditions other than neoplasm. The oldest patient was 83 and 7 were in the 70's. Thirty three, including the 13 just mentioned are known now to be dead and 71 are living from 1 to 36 months. Temporary nephrostomy was necessary on 3 patients and 1 other patient is now carrying nephrostomy tubes during convalescence from cystectomy. One nephrectomy was necessary. One ureter was successfully implanted into the bowel a second time. Three patients had one or both ureters transferred from the bowel to the skin because of poorly functioning ureterointestinal anastomoses. In brief of the 307 urethral transplantations to the bowel 26 were unsuccessful because of the postoperative death of the patient 1 was unsuccessful as nephrectomy became necessary 5 were failures because the ureter was necessarily transferred to the skin and 3 at this time must be called failures because the patient is wearing bilateral nephrostomy tubes. The second implantation of one ureter was only a partial failure as the second attempt remained successful over a year later. Thus, of 307 transplantations 34 were immediate failures but 173 or 56 per cent were early successes.

JOHN A. LOER M.D.

BLADDER, URETHRA, AND PENIS

An Artificial Sphincter. FREDERIC E. B. FOLEY J
Urol. Balt. 1947 53 350.

In true incontinence there is escape of urine through an anatomically or neurologically incompetent sphincter. With complete incontinence the bladder is always empty. With incomplete incontinence the bladder partially fills and the urine which is excreted into the bladder in excess of "continent capacity" is not retained but escapes through the urethra.

Anatomic incompetence of the urethral sphincter is usually the result of trauma, obstetric, surgical or otherwise. Neurogenic incompetence of the sphincter is due to organic disease of the central ner-

vous system injury or anomaly causing permanent relaxation of the external sphincter. In females, incontinence may be caused by "idiopathic" relaxation of the sphincter which is not of traumatic or neurogenic origin.

Control of incontinence in the new way presented by the author is accomplished by a very simple mechanical device which functions pneumatically. The device has been called "an artificial sphincter." It is applied to the urethra which is compressed by air to prevent the escape of urine.

The artificial sphincter may be applied to the urethra in its normal anatomic relationships or to a segment of urethra surgically isolated from adjacent structures by a new operation which has been called a cutaneous tunnel operation.

The artificial sphincter consists of a pneumatic or inflatable incontinence clamp which compresses and occludes the urethra and an inflating device communicating with it by means of an air passage of rubber tubing. The device is carried in the pocket of the trousers.

The purpose of the cutaneous tunnel operation is to permit application of the pneumatic incontinence clamp to an isolated segment of urethra without encirclement and constriction of the rest of the corpus, particularly the cavernous bodies, to the end of avoiding engorgement and partial erection distal to the site of application. This form of application permits maximal effectiveness in occluding the urethra by a clamp of minimal size requiring the smallest possible displacement of air. JOHN A. LOER M.D.

Exudative Cystitis. J. A. BERRY and E. BERRY J
Urol. Balt. 1947 53 360.

In a series of 24 cases of acute exudative cystitis, a few cases were complicated by arthritis, conjunctivitis, iritis, and dermatitis.

The acute vesical syndrome is characterized by a profuse bacterial pyuria and gross hematuria. The end result of the inflammatory lesion is a contracted and ulcerated bladder with terminal ureteritis and marked dilatation of the upper urinary tract.

The authors believe that the condition is caused by an organism possibly a spirochete and that it has some relation to nonspecific urethritis.

The differential diagnosis concerns the exclusion of gonorrhea, tuberculosis and malignancy. Familiarity with the symptoms and the roentgenographic findings makes the diagnosis simple.

Characteristically the whole picture can be reversed in a short period of time with specific treatment usually the neosarphenamines are employed. Mapharsen in the experience of the authors, has been equally efficacious. JOHN A. LOER M.D.

The Treatment of Serious Tumors of the Bladder. R. OCHER WARD, ARTHUR JACOBS, II, F. WIDEBURY WHITE, DAVID BAND, and Others. *Brit. J. Urol.* 1947 9 744.

In this symposium it was attempted to assess the relative values of partial and total cystectomy

WARD classified bladder growths as papillomas, both 'potentially' benign and 'potentially' malignant and carcinoma divided into infiltrating and noninfiltrating papillomatous types nodular and ulcerative types and adenocarcinomas. In potentially malignant papillomas he gives cystoscopic fulguration (diathermy) a trial first. In true carcinoma, when partial cystectomy is employed he removes the entire growth together with a wide margin of mucosa and the entire thickness of the bladder wall. Reimplantation of the ureter into the bladder is done whenever necessary. The worst results occurred in nodular infiltrating carcinoma. Possibly the growth was not removed widely enough (with sufficient margin of apparently healthy tissue). Excision should be done with a diathermy knife. Another cause of failure is the failure of recognition of extensions outside of the bladder in the adjacent tissue. In open operations upon papillomas reimplantation of pieces of tumor may occur. Iliae lymph nodes may already be involved at the time of operation. Distant metastases may be present. Ward palpates the liver through the opened peritoneum in each case. He thinks that total cystectomy is most effective in cases of malignant papilloma and much less effective in nodular or ulcerative growths. If a wide excision is impossible in attempting partial cystectomy the operator must go further and perform total cystectomy whatever its disadvantages and imperfections. Deep x ray therapy after radical operation is useless.

Preoperative accurate diagnosis should include accurate estimation of the size and appearance of the growths cystoscopically, possibly by insertion of a graduated ureteral catheter alongside the tumor. The posterior urethra should be inspected. A cystogram outlines large growths well. Excretory urography demonstrates ureteral obstruction and possible renal tumor. Bimanual examination under anesthesia is very important. A search for distant metastases is necessary. Cystoscopic biopsy should be done whenever reasonable. At operation the liver should be palpated, the extravascular extent of the growth estimated and the regional lymph node area should be examined. Ward suggests that when the partial cystectomy is completed a further small piece of adjacent mucosa and muscle in apparently healthy areas should be removed for examination. A pathologist should be present at the operation.

JACOBS employs segmental bladder resection only when the size and situation of the growth permits concomitant excision of a wide margin of healthy tissue as in tumors in the middle and upper zones of the lateral and posterior walls and on the superior wall. Tumors of the base or lower lateral walls are treated by open operation and insertion of radium. Good long term results are expected only when the tumors are of the papillary type. In advanced infiltrative growths total cystectomy is not worth while.

WENKSBURY WHITE employs interstitial implantation of radium needles. He found considerable lack of vesical irritation in cases of long survival.

BAND believed that total cystectomy was the operation to be aimed at. An infiltrated organ should be extirpated and if the tumor is not removed toxic absorption makes the patient gravely ill.

GALBRAITH believes that a cure is not a matter of 5 years but of from 15 to 30 years. Frequent follow up cystoscopy has been employed in his clinic for several years, with annual cystoscopy for at least 5 years thereafter. Small growths are fulgurated in the outpatient department without anesthesia. Low spinal anesthesia is used in large tumors and difficult cases. A patient unsuitable for transurethral treatment is hospitalized and treated by open bladder fulguration. Partial cystectomy is employed for ulcerated or infiltrating tumors. Radium needles are employed in selected cases. All radiation therapy is guided by a radiologist.

BERNARD WARD performs extensive fulguration on papillary growths. He prefers early cystectomy on primary ulcerating malignant growths. When infiltration of the base is rectally palpable the growth is inoperable.

TAIT (Australia) urged the active co-operation of the radiologist when radium is employed. Partial cystectomy is employed when the growth is not large.

MACK uses radium frequently even when a papilloma is fulgurated and the bladder wall at the pedicle base seems normal. Infiltrating tumors are thoroughly removed with the diathermy loop, the base is fulgurated and 0.5 or 1.0 mgm. radium needles are inserted at the tumor periphery. They are subsequently removed (usually in 7 days) through the suprapubic wound by withdrawing them with the attached linen threads. The suprapubic catheter remains in place for 3 weeks.

Total cystectomy is decided upon only after inspection of the growth in the opened bladder. If total removal is indicated the bladder is closed around a suprapubic tube, one ureter is transplanted and the bladder is removed when the other ureter is transplanted in a few weeks.

ROCHZ stated that loin pain associated with bladder tumor suggests ureteral obstruction usually by carcinoma rather than papilloma. In performing partial cystectomy he has ligated the ureter rather than reimplanted it.

WADZ used free wide excision, without fear when performing partial cystectomy.

POOLE WILSON suggested the use of radioactive fluid to prevent recurrences of bladder tumor in dye workers.

In summing up, the discussion disclosed differences of opinion about (1) the desirability of general anesthesia for cystoscopic fulguration (2) the wisdom of opening the bladder before deciding on treatment (danger of dissemination) and (3) the relative value of surgery and irradiation. There was general agreement about (1) the need for early cystoscopy and repeated follow up (2) the difficulty of deciding whether a growth was benign or malignant, (3) the necessity for combined treatment and (4) the belief that total cystectomy had its greatest field of use

fulness in the more extensive but less malignant papillary tumors. DAVIN ROSENTHAL 31 D

Transurethral Resection in the Treatment of Vesical Dysfunction Secondary to Inflammatory Degenerative and Traumatic Lesions of the Spinal Cord JOHN L. EWERTT and J. L. DIS-
QUIRRE Surg. Clin. N. Amer. 1947 32 950.

Prather suggested that the proper treatment of the acute phase of vesical dysfunction resulting from lesions of the spinal cord should consist of continuous drainage provided either by an indwelling urethral catheter or a suprapubic cystostomy tube. When these methods are used the bladder is kept clean by means of a closed system of irrigation by either the intermittent or automatic (tidal) method. The choice of urethral or suprapubic drainage depends on various factors among which are (1) the facilities available for the care of the patient (2) the type of nursing service, (3) urethral tolerance and (4) the length of time drainage is expected to be necessary. Some patients are able to tolerate an 18 F bag urethral catheter for long periods with no untoward results. In other cases there is a tendency for urethral infection and prostaticitis to develop; these complications may result in prostatic abscess (usually at the penoscrotal junction) and fistula. It is important to avoid such complications if possible as they greatly complicate treatment in the chronic stage. Administration of small doses of one of the sulfonamide drugs while a urethral catheter is in place will assist in the prevention of such complications. Each case must be considered individually; however, final decision is a matter of keen judgment on the part of the physician.

The matter of the closed system of irrigation is important. Munro and Hahn have advocated the automatic (tidal) variety of irrigation. They and other authors have demonstrated that the urine may be kept free of infection for long periods of time with this type of treatment; however, their assertion that tidal drainage will prevent hypertonicity and spasticity of the bladder in the chronic stage has not been substantiated by other authors.

The therapy of the chronic stage of the neurogenic bladder is primarily a problem involving the treatment of various types of hypertonic cord bladder. Almost the only exception to this statement is the atonic tabetic bladder. Vesical dysfunction in the tabetic patient responds well to transurethral resection of the vesical neck.

The remaining consideration therefore will concern the various types of hypertonic neurogenic bladders which constitute the overwhelming majority that are the end result of lesions of the spinal cord.

A total of 65 patients with chronic cord bladder have undergone transurethral resection at the Mayo Clinic prior to January 1946. Forty-five of these patients had transverse lesions of the spinal cord, while the remaining 20 had other lesions of the spinal cord, such as multiple sclerosis, combined sclerosis and miscellaneous lesions.

All of the transurethral resections in this series of cases were done with the Thompson cold punch with the usual technique. The object of the operation is to remove the vesical neck (so-called internal urethral sphincter) and any prostatic enlargement that is present. The resection must be complete and should be carried out to the region of the external urethral sphincter. If the external sphincter is not damaged incontinence will not result. The resection must frequently be done in multiple stages. Although the surgeon may feel sure that the resection has been complete, he will often find on subsequent examination that as much or more tissue can again be removed. It is wise to perform the resection in multiple stages in some instances because if one tries to resect too deeply in the muscular tissue at the vesical neck at the first stage, troublesome bleeding may be encountered and may prove difficult to control. In the 45 cases of transverse lesions the resection was done in one sitting in 34 cases, in two stages in 7 cases, in three stages in 3 cases and in four stages in 1 case. The amount of tissue removed is usually rather small unless the patient is an elderly person. However, young patients in whom the cord lesion has been present for many years may have a large amount of hyperplastic tissue at the vesical neck. In the series of 45 cases under consideration, the amount of tissue removed varied from 1 to 34 gm.

The results of transurethral resection in these 45 cases were gratifying. Excellent results were obtained in 33 cases, in 7 cases, the patients were greatly improved, in 3 cases fair results were obtained and in 4 cases the patients were unimproved.

Surgical treatment should be postponed until the patient is in good general condition and until the decubitus ulcers are well controlled. It would also be desirable to await some return of vesical tone. Whether or not one should wait longer than 3 or 4 months for this to occur is doubtful, however.

The results of transurethral resection in cases of multiple sclerosis have not been as consistently good as the results in cases of transverse lesions of the spinal cord. Three patients obtained good results, and in the other 4 cases the results were only fair. Resection was done only once in each of the 4 cases in which the results were fair; therefore it is entirely possible that further resection might have been beneficial, as is so often true in cases of transverse lesions.

Transurethral resection was performed in 5 cases of combined sclerosis and the results were good in 4 cases. Of the remaining 3 cases, the results of transurethral resection were good in 3 and poor in 1 case.

Primary Carcinoma of the Male Urethra. JERRY ZARLOW and JAMES T. PRINGLEY J. Urol., Balt. 1947 58 707

Twenty-five cases of primary urethral neoplasm have been encountered at the Mayo Clinic from 1910 to 1945, inclusive. The diagnosis was established by microscopic examination in all but 3 of these cases. In all of the cases studied histologically the diagnosis was epithelioma. No adenocarcinomas of the glands

of Littre were encountered. Cases of adenocarcinoma in the posterior urethra have not been included.

The growth was situated anteriorly in 10 cases and posteriorly in 14, and in 1 case both the anterior and posterior urethra was involved a proportion in accord with reports in the literature. There was little difference in the symptoms and clinical characteristics regardless of the location of the growth, however the most common initial symptom for an anterior lesion was difficulty in micturition whereas for a posterior lesion hematuria was most often the presenting symptom. If a growth is of appreciable size it can be palpated especially if it is located in the anterior urethra. Six of the 25 patients presented a history of urethral stricture prior to the onset of symptoms referable to the neoplasm an incidence which seems somewhat more than coincidental. The average age of the patients was 56 years and the youngest one was only 28 years of age. The grade of malignancy was determined in 20 cases and in 19 was either 2 or 3.

Treatment varied according to the location and extent of the lesion. In the 10 cases in which the growth was located in the penile urethra amputation, radium, and fulguration were employed with equal frequency. Amputation which may be partial rather than complete, is preferable for the more extensive lesions. It is well to remember however that a partial amputation which leaves virtually no urethra which may be grasped during micturition to direct the stream may be more of a handicap to the patient than a perineal urethral meatus which can always be used satisfactorily in the sitting position. For a relatively small growth in the region of the fossa navicularis radium may be applied directly. Fulguration can be used to destroy a relatively small lesion. If there is any doubt regarding the complete destruction of the growth *in situ* by either of these methods, amputation would seem the treatment of choice.

Treatment of an epithelioma situated in the membranous or prostatic urethra is somewhat more difficult. In the present series of cases, prostatectomy, cauterization, application of radium, transurethral removal and fulguration and roentgen therapy were employed. Obviously there must be individualization in the choice of treatment, according to the exact location and extent of the lesion. Experience has been too limited to permit general conclusions but obviously the same principles apply in the treatment of a malignant lesion in the posterior urethra as in other parts of the body, namely complete removal or destruction of the growth if at all possible.

The prognosis in the anterior cases seems more favorable for lesions in the anterior than in the posterior urethra. Since at least half the patients with anterior urethral lesions are living 5 years after operation, while half of those with posterior urethral lesions were dead a year after operation probably the difficulty of complete removal of a growth situated posteriorly may be a factor in this regard. Of

the 10 patients who had an epithelioma in the anterior urethra 3 are known to be dead and 7 are living. Three of these 7 have had a recurrence and none of them is known to have survived for as long as 5 years. The shortest postoperative follow up in this group of 7 patients was 5 months and the longest 5 years, the average being 21 months.

Of the 14 patients who had lesions in the posterior urethra, 12 are known to be dead however 1 of these lived 4 years and another 9 years and at the time of death had no evidence of recurrence. One of the 14 patients was alive and apparently well at least 5 years after treatment and 1 patient has not been traced. The patient who had a lesion which involved both the anterior and posterior portions of the urethra died 4 months after treatment, which consisted solely of roentgen therapy. Obviously the results in both groups of cases leave much to be desired. However the fact that a few patients have survived as long as 5 years affords some encouragement. For the most part treatment in these cases consisted in complete surgical removal or local destruction of the lesion.

GENITAL ORGANS

The Obstructive Prostate. FRANK HUNNAN, J. AM. M. 43: 1247 135 136

The obstructive prostate is of several varieties benign enlargements and median bar formations are almost always obstructive inflammations, cysts, prostatic calculi, leiomyomas and fibromyomas occasionally are obstructive, but cancer is infrequently obstructive unless it is associated with one of the preceding conditions. The present discussion is limited to benign enlargement and carcinoma of the prostate.

The majority of authorities believe that benign enlargement of the prostate is a new growth of fibrous muscular and glandular tissues serving no physiological purpose. It is not invasive but always encapsulated and with growth it compresses the uninvolved parenchyma of the prostate into the so-called false capsule from which it can be enucleated en masse. A theory of origin of the growth assumes that the initial lesion is a fibrous nodule which stimulates extremely early and rapid penetration of glandular elements from the periphery. The process begins in the submucosa of the prostatic urethra and vesicle neck as multiple outshoots of young spindle cells which soon develop into small fibromas and fibromyomas which are quickly invaded by the ingrowth of the adjacent glandular tissues to form the pathological picture of fibromyoadenomas the benign enlargements of the prostate.

Cancer of the prostate also occurs in later life and the two often occur together but are unrelated otherwise. Cancer arises from any part of the parenchyma of the true prostate usually in the periphery. Only early lesions near the surface of the posterior portion are palpable per rectum. All other lesions, no matter where they start would extend to involve

the posterior portion and be palpable but their diagnosis then is late and the late lesion is incurable. Because of the recent advent of endocrine therapy and relief of obstruction in the treatment of cancer of the prostate, the author wishes to determine whether early diagnosis and radical surgical procedures are still applicable in its treatment. In order to better analyze the problem he approaches it from four standpoints: (1) a discussion on what is known about cancer, (2) what happens without any treatment, or with the ineffective methods of radium and x ray therapy, (3) how effective is endocrine therapy, (4) what has been accomplished by early diagnosis and radical surgical intervention?

1. With the lengthening of life expectancy there has been an increase in the number of deaths from cancer. About seventeen million of the approximately seventy million males in the United States are over 50 years of age. The incidence of cancer of the prostate in this group is variously estimated from 14 to 16 per cent. This means that at least three million to five million and possibly as many as eight million Americans now have cancer of the prostate. It is almost universally agreed that primary cancer arises in the prostate gland unrelated to enlargement which arises from the perurethral glands. It seems reasonable to conclude that cancer may start in any portion of this part of the gland. It then spreads within its capsule so that no matter where it started the posterior portion is involved before invasion of the seminal vesicles; hence the problem of early diagnosis is not only the discovery of the primary lesion by rectal palpation but also the development of methods by which the occult forms of cancer which are not palpable may be discovered. According to Kahler involvement of the perineural lymphatics is one of the earliest changes in cancer of the prostate. Opponents of radical intervention believe that lymphatic invasion means metastasis and therefore, since neither the primary or secondary lymph zones of the prostate can be removed, an operative procedure is useless even in early diagnosis. They overlook the fact, however, that this early invasion of lymph spaces surrounding the nerve is confined within the true capsule of the prostate for a long time. Extension into the vesicles, invasion of distant lymphatics, bones, and viscera by way of the blood stream are late manifestations. Complete removal and cure of the lesion while it is limited within the prostate is possible, and has been accomplished repeatedly even when perineural lymphatics in the capsule have been invaded.

2. Studies of what happens without treatment are few but studies which have been carried out indicate that between 90 and 95 of every 100 men will succumb within 5 years of the time cancer strikes them. Inasmuch as the life expectancy at 60 years of age is 17 years, then of 100 men at 60 years, between 80 and 85 of them will be living 5 years later but if all at the age of 60 had had prostatic cancer more than that many would be dead. In other words from 10 to 15 of 100 men with cancer at the age of 60 will die

from other causes and from 80 to 85 will die from cancer within 5 years. This big difference in mortality rates between a group without cancer and a group with cancer shows the error in the general attitude of indifference which arises from a belief that these men haven't long to live anyway.

3. None of the experiences with castration and endocrine therapy have as yet covered a 5 year period. Analysis of the reports which have been presented indicate that in a 5 year period almost as many will die as in the untreated series. The real benefit that most patients with advanced cancer of the prostate derive from hormonal therapy must be minimized. The relief from pain, the improvement of urination with recession of the local growth, and gain in general health are often remarkable. The immediate benefits are not permanent and the cancer may show an increase of virulence later.

4. Of 100 men with cancer of the prostate, only about 5 are seen early enough to justify radical surgical procedures. Series of cases have been reported with 48 per cent and 56 per cent 5 year cure, respectively. Cancer involves the prostatic gland first, arising as a rule near the periphery of that portion involved. It grows slowly in the beginning and there is ample time for early recognition. If it is located in the posterior portion it may be palpable per rectum. If in the lateral, anterolateral, or median portion, it may be suspected and discovered by other methods.

The early lesion in the posterior portion gives the sensation of stony hardness. It feels flat rather than spheric. It is just beneath the capsule, more superficial than deep and it has a sharp edge or corner. It is perceived best with the patient leaning forward with hands on a chair or elbows on a table, feet apart. Local lesions of inflammation are rounded or nodular and an x ray picture of the area is always indicated in order to rule out the presence of stone as the cause of the induration. When the observations are characteristic or suggestive enough, the patient should be prepared for the perineal operation, at which the area is exposed and a biopsy should be taken and examined immediately by frozen section. If positive, radical removal is completed. Associated enlargement can be enucleated or if it is small a transurethral section can be done at once through an opening in the urethra before closure of the perineum. Needle biopsies are misleading and have been largely abandoned. Primary lesions which cannot be palpated per rectum may be discovered by microscope study of material removed at transurethral resection or of the specimen after penile or suprapubic enucleation for enlargement. These cancers invade the enlargement at its periphery. They start in the parenchyma of the gland compressed by the enlargement to form its false capsule. Resections should put aside for particular microscopic search the material removed from the deeper peripheral portions of the enlargement.

Many writers believe that enlargement is never a focus of origin for carcinoma of the prostate. Even

If this is only partially correct, every suprapubic and perineal prostatectomy should be followed by a careful search of the surface of the specimen and of the cavity left after enucleation, and a biopsy with frozen section of any areas at all suggestive should be made. A cure by radical removal is then possible.

The evidence now available indicates that discovery of cancer by early diagnosis should be made while it is limited within the capsule of the prostate, that radical surgical intervention at this time will cure over 50 per cent of the patients, and that to increase the number of early diagnoses above the present dismal 5 per cent is a worthy effort.

It is evident also that benign enlargement and carcinoma are distinct and separate lesions of the prostate, even though they commonly occur together.

ROBERT O. BRADLEY, M.D.

Retropubic Extravesical Prostatectomy Millin's Operation Technique and Indications (*L'opération de prostatectomie rétro-pubienne extra vésicale. Operation de Millin Technique et Indications.*) R. GOUVERNEUR, P. ANTOULET, and A. DUBOIS. *J. chir. Par.*, 1947 63 425

Seventy prostatectomies by Millin's method have been performed by the authors. Two fatalities occurred and in 1 case incontinence developed but healed spontaneously within a year. In 5 patients secondary cystostomies, and in 2 others secondary endoscopic resections, were required. In 12 patients primary and secondary hypogastric fistulas followed the operation and closed within 20 or 30 days after insertion of a retention catheter. The first operation was performed more than a year prior to the publication of this article and so far no undesirable late sequelae attributable to the intervention have been noticed.

The authors performed the operation on 2 patients who had had cystostomies. A retention catheter was introduced through the urethra after a débridement of the margins of cystostomy. Both patients recovered but the duration of the convalescence was not shorter than that usually observed after Freyer's operation.

Millin's operation offers certain advantages over the perineal prostatectomy: the prostatic gland is approached anteriorly which avoids injury to the rectum, and also to the verumontanum which may lead to sexual impotence. The danger of injury to the striated sphincter, with the resulting incontinence of urine, is also avoided.

The use of Millin's retractor greatly facilitates the operation. An electric knife and a suction apparatus are indispensable. The authors advocate spinal anesthesia. The patient is placed in a horizontal position with the head slightly lowered. The incision should not extend more than 5 or 6 cm. above the symphysis pubis. Pfannenstiel's incision may also be employed. The success of the operation depends upon good exposure. The capsule is incised in a transverse direction as high as possible usually about 0.5 cm. below the vesicoprostatic groove. One of the assistants

elevates the prostatic gland with two fingers introduced into the rectum. The digital enucleation of the adenoma starts at its lower pole. After a section of the vesicourethral mucosal cuff, the adenoma is removed. The posterior lip of the cervicovesical orifice is resected to prevent a stricture. A catheter is introduced into the bladder through the urethra. A rubber drain and sulfanilamide are placed into the wound which is then closed. The vasa deferentia are closed at the beginning or at the end of the operation.

The following postoperative complications may develop:

- 1 Displacement of the catheter or its occlusion by blood clots. To avoid this complication the catheter should be attached to the prepuce with a suture and it should be irrigated at frequent intervals. Sometimes a suprapubic cystostomy may be necessary.

- 2 Intravesical hemorrhage. If lavage of the bladder does not stop it cystostomy with or without packing of the cavity resulting from the prostatectomy should be done.

- 3 Formation of a suprapubic fistula which may develop soon after the operation or after removal of the catheter. The first type is caused by an insufficiency of the suture of the prostatic capsule and is of no great clinical importance. The second type can be cured by insertion of a retention catheter through the urethra. Incision through the capsule should be done with a scalpel, in preference to an electric knife to avoid a superficial necrosis of the margins of the wound. A good grade of chromic catgut should be used for the sutures. Finally the administration of plasma or amino acids to correct nutritional deficiencies helps to avoid the formation of a secondary fistula.

- 4 Retention of the urine can usually be avoided by wedge shaped resection of the posterior lip of the neck.

- 5 Incontinence of the urine can be prevented by sectioning the urethra with scissors to avoid laceration.

Millin's operation should not be performed in the presence of a urinary infection. The operation is indicated in the presence of an intraprostatic adenoma of medium size. It is very difficult to find a small adenoma and it can be removed more efficiently by endoscopic resection. Giant adenomas should be excised through the bladder. The operation is contra-indicated in obese individuals for technical reasons.

JOSEPH K. NARAT, M.D.

Misconception of the Gubernaculum Testis. L. J. WELLS and DAVID STARR. *Surgery* 1947 22 302

Because of the many descriptions in the literature of the gubernaculum testis there has been a great deal of confusion concerning it. The main object of the present study was to determine whether the gubernaculum could be identified in surgical patients. A second and related objective was to search for any discrete band of tissue which might account for the widespread opinion that the gubernaculum

extends below that part of the inguinal bursa which normally becomes the spermatic sac.

Four patients were selected for careful study. During surgery the procedure was (1) to identify the inguinal bursa, (2) to search for a cord of tissue below its blind end (3) to open the bursa in order to note any manifestations of a gubernaculum on its posterior aspect, (4) to tag crucial portions of the bursa for the purpose of orientation in microscopic studies, and (5) to remove the bursa plus attached strands of tissue after freeing the testis. The surgical specimen thus obtained was fixed and studied microscopically.

It was found that sections of the gubernaculum could not be identified in any of the microscopic preparations of the 4 surgical specimens. Therefore only 1 of the case reports is presented in detail.

In this case, the patient was a white male 12 years of age with the main complaint of failure of descent of the testis bilaterally. One year previous he had received a series of 16 injections of gonadotropin without benefit. The patient's father and 3 brothers each had unilateral failure of descent of the testis.

Physical examination revealed a well nourished, well developed boy who was not acutely ill. The examination was negative save for a bilateral cryptorchidism and a left inguinal hernia. The left testis could be felt high in the inguinal canal but the right testis could not be palpated at all.

Surgery was done on July 1, 1946 and the following observations were made. The inguinal ring was visible as soon as the skin and subcutaneous tissues had been incised. A structure in the inguinal canal, subsequently identified as the testis, could be moved upward and downward by exerting manual pressure, but it would not pass through the external ring. The first indication of an inguinal bursa to appear was an indistinct outline of its fundus. Below the fundus it was impossible to see or to palpate any cord of tissue which might be said to resemble a gubernaculum.

When the bursa was opened the testis could be seen through its thin covering of peritoneum. A gloved finger in the peritoneal sac could enter the abdominal cavity by passing through the patent orifice of the bursa. Extending down from the tail of the epididymis was some unknown retroperitoneal structure that elevated the peritoneum to produce a longitudinal ridge. Aside from its narrowness, this ridge looked somewhat like that caused by a gubernaculum. It was tagged by means of a thread then this structure the part of the bursa distal to the testis, and the attached "ligament" were excised as a unit and placed in fixing fluid.

In microscopic studies of transverse sections of the bursa, the 4 layers of its wall were observed. The most distinct ones were the peritoneal and the cremasteric. Since a gubernaculum, like a testis, is a retroperitoneal structure, the internal spermatic layer is the one which should be expected to contain it. Despite most careful search no trace of a guber-

naculum could be found. Transverse sections of the tissue tagged by means of thread showed that the ridge of peritoneum observed during surgery was caused by blood vessels in the subperitoneal layer.

A block of tissue including the fundus of the bursa and the upper part of the attached "ligament" was sectioned serially and vertically. The sections showed that the "ligament" consisted of areolar tissue, fat, and small blood vessels.

In this case, it is clear that the "ligament" created by blunt dissection should not be called gubernaculum testis. On the posterior aspect of the internal spermatic layer of the bursa where a gubernaculum, if present, should be expected to lie, none could be found. These observations, however, should not be taken to mean that a gubernaculum could not be identified in all of the patients with an undescended testis; they are evidence against the common notion that a place to look for one is below the bottom of the bursa.

In conclusion the authors state that they were unable to identify a gubernaculum in any of 4 selected patients who were subjected to orchiopexy. The notion that it may be found below the fundus of the inguinal bursa in such patients is due to a misconception. If present, it should lie on the posterior aspect of the bursa and in the internal spermatic layer.

R. O. BRADSHAW, M.D.

On Malignant Tumors of the Testis. See GORDON GORDON TAYLOR and NORMAN E. WYNDHAM. *Ann J Surg* 1947 35:6.

The authors describe their experience with over 700 patients suffering from primary malignant neoplasms of the testis. Secondary malignancies are rare—only about 50 having been recorded in the literature. Metastatic carcinoma of the epididymis is still more exceptional—only 3 cases having been reported.

The authors distinguish 3 main types, namely the teratoma and the seminoma which can be easily recognized grossly; these tumors should be confirmed microscopically. Of 688 cases of testicular tumor, 461 (67 per cent) of the tumors were seminomas while 227 were regarded as teratomas. Chorioncarcinoma accounted for a little more than 1 per cent of the lesions, while sarcoma was very rare.

Seminoma is a seminal carcinoma and is unrelated histogenetically to teratoma. Willis believes that (1) transitions from seminal tubules to tumor can often be traced, and the appearances cannot be explained by secondary invasion of the tubules. (2) serial sections of seminomas, even small ones, show no teratomatous elements. (3) undifferentiated embryonic epithelial tissue is a frequent component of malignant teratomas. (4) when genuine seminoma and teratoma coexist in one testicle there is often distinct separation of the two neoplasms by testicular tissue or a fibrous capsule.

The radical operation is today employed under exceptional circumstances by a few surgeons. Even Hlman has recently performed a radical operation after irradiation in 3 out of 58 cases. Nowadays the

operation of choice is a simple mundane surgical exercise akin to that performed with consummate skill and dexterity by veterinary surgeons. Simple excision of the malignant testis should be combined with irradiation. This therapeutic combination has improved the prognosis. **ROBERT TUCKER, M.D.**

MISCELLANEOUS

Glandular Metaplastic Malignancy W. E. KIRKIDGE, JOHN C. HENNINGSEN, and MARK WHITEHEAD *J. Urol.*, Balt., 1947 58 282

Tumors in the urinary tract which contain glandular elements are not commonly seen but when they do occur they present certain practical and theoretical problems as to (1) whether the glandular elements represent metaplasia of transitional epithelium to glandular epithelium (2) whether the lesion is primary in the urinary tract or metastatic from the intestine or other glandular organs, and (3) whether the tumor arises from known glandular elements at the attachment of the urethra or around the urethral neck.

Transformation of the urinary epithelium from transitional to glandular type is known to occur in

ectrophy of the bladder and is said to take place in cystitis cystica. Metaplasia of this type in tumors was described by Stoerck as early in 1899, and in 1907 Stoerck and Zuckerkandl called attention to the similarity between the glandular tissue of tumors of the bladder and the mucosa of the large intestine.

In a recent review of the literature Foot gives an excellent discussion on metaplasia of urinary tract epithelium and reports 3 cases the metaplasia occurred in the epithelium of the renal pelvis in 1 case and in the epithelium of the bladder in the other 2 cases. In 1 of the latter 2 cases a malignant tumor (adenocarcinoma) was found.

The authors report 4 cases of glandular carcinoma of the urinary tract to illustrate the difficulty of determining whether an adenocarcinoma is primary or secondary in this location. In 1 case the tumor of the bladder was probably metastatic from a carcinoma of the colon. In 2 cases the adenocarcinoma probably arose from plaques of urinary tract epithelium which had undergone metaplasia to the secretory type. In 1 case metaplasia of the epithelium to the secretory type evidently occurred in an infiltrating transitional cell carcinoma.

JOHN A. LOFF, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

On the Problem of Trauma and Aseptic Osteonecrosis. IVAN HENRIKSSON. *Acta radiol* Stockh. 1947 8 357

Aseptic osteonecrosis may be caused by a trauma, or there may be a predisposing factor of some kind. In trauma, the fracture or a vascular disturbance alone may be responsible for the aseptic necrosis or the fracture and a vascular disturbance may be responsible jointly. The possibility that the predisposing factor may be localized in the bone nucleus or in the vasomotor nerves of the autonomic nervous system is considered. Three case histories are presented in detail.

The first case was an injury to the elbow and resulted in an aseptic necrosis in the capitellum and in the head of the radius. The second case was a fracture of the epiphyseal nucleus of the head of the radius and a fracture of the metaphysis. In this case, Schlatter's disease developed shortly afterward. In the third case, osteochondritis dissecans occurred in the lateral malleolus after trauma to the ankle.

In the cases in which an x-ray examination was made immediately following the injury a primary fracture was excluded. Thus, it is assumed that the trauma gave rise to a vascular disturbance which subsequently caused necrosis. There was no indication in any of these cases that there are any predisposing factors. RICHARD J. BENNETT JR., M.D.

Generalized Lipoid Granulomatosis. TORFINN DREISAD. *Acta radiol* Stockh. 1947 18 269.

A case report is presented of a man 55 years of age whose condition was diagnosed as congenital syphilis and leg ulcers. At another time a diagnosis of peritonitis and osteomyelitis was made. Multiple operations were performed on several bones of which the microscopic examination showed no indication of tuberculosis or syphilis. Subsequent multiple fistulas occurred in other portions of the body. At the age of 37 he had developed a fracture of the left upper arm. Between the ages of 50 and 55 he was given extensive treatment because of an ulceration of the right leg. In other words, many variable diagnoses were made over a period of years.

The author believes that osteitis fibrosa generalisata must be considered as a diagnosis, and he discusses Albright's disease also. In the x-ray department, it was concluded that this case was probably one of generalized xanthomatosis or more clearly termed, lipoid granulomatosis which is a form of Hand-Schüller-Christian's disease. The blood cholesterol showed high normal figures. From the high cholesterol figures and study of the clinical course in retrospect the diagnosis of xanthomatosis was made. RICHARD J. BENNETT JR., M.D.

Multiple Myeloma: A Survey Based on 25 Cases, 15 of Which Came to Autopsy. LOUIS LOEWENTHAU and HENRY L. JAFFE. *Arch. Path.*, Chic., 1947 44: 307

Multiple myeloma is a clinically and anatomically distinctive malignant disease of the skeleton apparently arising from the myeloid formative tissue. It is somewhat more common in males and in the fifth and sixth decades of life although it is not uncommon in the thirties. A few unequivocal cases have been reported in adolescents. In some cases the disease may be localized to a focus in one bone only for years. Although the bony framework may be riddled with foci of myeloma, it is only infrequently that gross myelomatous foci are found in the viscera and other extraskelatal parts. In some cases myeloma cells invade the blood stream and may create a leucemic blood picture (so called plasma cell leukemia).

The patient usually presents himself with a complaint of pain, especially of the back and thorax, often vague and generalized and accompanied by a feeling of weakness. The weight loss is usually substantial. Pathological fracture of the spine or long bones is common. With involvement of the lumbar region scoliosis was a common symptom. Sometimes a palpable tumor of an exposed bone such as a rib or clavicle is the presenting complaint. The course of the disease varies a great deal. The average period of survival following the onset of symptoms was about 3 years, although 2 patients survived 9 years and another is still alive 10 years after the onset. Long periods of remission are apparently spontaneous and not related to treatment.

The roentgen picture of multiple myeloma varies. In advanced cases many bones, including the calvarium, are riddled by osteolytic defects. In other cases (when myelomatous infiltration of the bone marrow is diffuse) roentgen changes may be minimal. If the infiltration is generalized marked anemia may result. Sternal bone marrow studies should be made whenever the presence of myeloma is suspected, and especially when biopsy of some obviously affected bone is not feasible. Hypercalcemia (ranging as high as 18 mgm. per cent) is present in about one half of the cases, reflecting the lytic resorption of the bones. The kidneys in such cases tend to show deposits of calcium granules in the tubular epithelium and interstitial connective tissue, and renal failure may develop. It should be possible to distinguish this condition from hyperparathyroidism since the serum phosphatase activity tends to be normal no matter how extensive the skeletal involvement may be. Hyperglobulinemia (from 3 to 14 gm. per 100 c.c. of blood by the Howe method) is observed in about half of the cases. The serum albumin level is either normal or diminished, apparently because of loss of albumin through the damaged renal tubules. The presence in the urine of protein, giving the Benedict

Jones reaction is noted in about 50 per cent of the cases. Its excretion may be intermittent. Protein excretion in the urine very rarely occurs in other conditions (senile osteomalacia, gunshot wounds, polycythemia). Amyloidosis is noted in about 10 per cent of the cases and amyloid deposits may be found in great quantity in the skeletal connective tissue generally.

Cytologically multiple myelomas may be divided roughly into two groups (1) those in which the tumor cells are quite uniform, predominantly small and have a superficial resemblance to plasma cells (hence the term 'plasma cell myeloma') and (2) those in which the characteristic cell is considerably larger and more variegated. The authors emphasize the unity of multiple myeloma and explain cytologic variations within them as expressions of their relative maturity or immaturity. The identification of the common ancestral cell of multiple myeloma is still a moot point, but this is probably of myeloid formative or hematic origin. Since multiple myeloma is such a distinctive disease entity clinically and anatomically it seems unreasonable to attempt to subclassify it into plasma cell myeloid erythroid and lymphoid myeloma.

Problems in therapy are concerned mainly with relief of the distressing bone pain, general supportive measures, and the care of such complications as pathological fractures and cord compressions. X-ray therapy may relieve the bone pain although it apparently has little influence on the course of the disease. Radioactive phosphorus sometimes results in subjective improvement, although it probably is not as effective as roentgen therapy and may produce a dangerous leucopenia and thrombocytopenia in some cases.

Stilbamide and 'pentamidine' in conjunction with a diet low in animal protein have been advocated. But palliation only is claimed for these drugs and they are not without distressing side effects.

Blood transfusions should be given for marked anemia. Laminectomy (followed but not preceded by roentgen therapy) may permit recovery of function for a number of years when transverse myelitis results from extradural compression.

VERNON C. TURNER, M.D.

Benign Central Cartilaginous Tumors of Bone.

BRADLEY L. COLEY and ANTHONY J. SANTORA, *Surg. Gory.* 1947 22 411

In a study of the records of 22 central chondromas the authors concluded that there may be a long latent period during which the presence of the lesion is not suspected. Usually the tumor is noticed between the ages of 10 and 30 years. It appears more commonly in the long bones. Both sexes are equally affected. About one-third of the cases present involvement of the phalanges. This lesion is the most frequent tumor found in that location.

A simple chondroma may be completely symptomless. When it has altered the contour of the bone the patient may notice swelling or deformity. Pain

when present is generally inconstant and mild. Disability is infrequent. Pathologic fracture especially in phalangeal chondromas is often the incident which precipitates recognition of the condition. The trauma which results in the fracture is often trivial and nearly always less severe than that which is responsible for simple fractures through normal bone.

Grossly, the tumor lacks the appearance of tissue seen in simple cysts, giant cell tumor or fibrous dysplasia. It presents a solid whitish firm mass completely filling the cavity and has a slightly gritty feel when attempts are made to remove it with the curette. At times calcific particles are seen and felt, but the purely fibrous quality of fibrous dysplasia, the vascular reddish nature of giant cell tumor and the fluid filled spaces of simple cyst are lacking. Myxomatous changes are not uncommon and it is probable that the extremely rare cases of pure myxoma of bone which have been reported are examples of degeneration of a central chondroma. While not encapsulated, the lesion is usually rather definitely circumscribed and for this reason it is possible to remove it completely by painstaking curettage. The cells are usually rounded but may vary in size and may become fusiform or stellate. Calcification may be seen in scattered areas.

In the x-ray film it is often possible to confuse the picture with that presented by bone cyst, giant cell tumor and nonosteogenic fibroma of bone. The treatment of central chondroma is surgical. For lesions in the rib, fibula, and scapula resection of the entire tumor bearing area is indicated. When the involved area constitutes a considerable proportion of the thickness of the shaft of an essential long bone (femur, humerus, tibia) it is important to utilize bone chips from the ilium or pencil grafts from the tibial cortex to fill the defect and to assure more complete and more rapid bone regeneration.

In this series of 22 patients there were only 2 recurrences of the tumor. Both of these were successfully managed by reoperation. Roentgen therapy is not satisfactory.

The authors state that the benign chondroblastoma is not a giant cell tumor and that it belongs properly with the tumors of cartilaginous origin. Jaffe and Lichtenstein considered it to be distinct from giant cell tumor and not even a variant of it. They termed it a benign chondroblastoma. This lesion is not confined to the upper humerus as is noted in Codman's original description of the tumor. Roentgen therapy may be successful in chondroblastoma in contrast to its effect on central chondroma. Chondroblastoma more closely resembles giant cell tumor than does central chondroma. At times chondroblastoma presents roentgen evidence suggestive of a malignant bone sarcoma. Pain and swelling at the site of the lesion is the usual complaint. Trauma has not been shown to be of etiologic importance although an injury to the part might well attract the patient's attention to it.

C. FRED GOERINGER, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Diagnosis and Treatment of Recurrent Dislocation of the Shoulder ROSS ROBERTSON and W J STARK. *J Bone Surg* 1947 29: 197

Twelve patients with anterior dislocation and 3 with posterior dislocation of the shoulder were treated by open operation. All of the injuries were traumatic in origin and there had been multiple recurrences. These operations were performed from 7 to 18 months previous to the publishing of this article. Thirteen of the 15 patients have returned to work, and most of the patients do hard labor. There has been an average of from 10 to 15 degrees of limitation of external rotation and abduction in the anterior dislocations and a similar limitation of internal rotation and abduction in the posterior dislocations.

The author suggests that through a posterior lateral incision the acromion be divided and rotated outward to give free access to the joint. The operation consists mainly in locating the lateral edges of the ruptured capsule and suturing it securely to the edge of the glenoid. The structures are then anatomically put back into normal relationship.

RICHARD J BROWNE, JR., M D

Metacarpal Reconstruction. J WILLIAM LITTLE. *J Bone Surg* 1947 29: 7-3.

The main reason for metacarpal reconstruction is the restoration of function. The success of the operation is in direct proportion to the accuracy with which the graft is fitted to the carpal, metacarpal, or phalangeal fragments. If only the head of the metacarpal remains, it can be stabilized by extending the graft into the carpus. If only the base remains and the finger is preserved the graft can be fused to the proximal phalanx at 30 degrees of flexion.

When there are multiple metacarpal defects multiple bone grafts may be placed in one operation. If the proximal portion of the first metacarpal has been destroyed the distal fragment may be fused to the carpus if the thumb is placed and maintained in a functional position. If an injury should involve the distal portion of the first metacarpal with extension into the metacarpophalangeal joint, a fusion of this joint at approximately 30 degrees of flexion is recommended. At the time of operation, all the scar tissue is resected. The proximal fragment is recessed with an osteotome at an angle of approximately 30 degrees. The distal fragment is cut transversally and the medullary cavity is opened to receive the doweled end of the graft. The defect is carefully rebuilt with a graft measuring at least $\frac{3}{4}$ inch longer than the estimated defect. The dowel is formed at one end of the graft and the other end is cut obliquely at 30 degrees. The ends are carefully closed over the graft. The various steps of the operative procedure are illustrated in the original article. Following the operation a plaster-of-Paris cast is applied. A period of 3 months is required for good union. Forty-four patients, with a total of 56 individual grafts have been

operated upon. Two small grafts were absorbed and 1 graft failed to unite.

RICHARD J BROWNE, JR., M D

Ambulatory Treatment of Hallux Valgus. EDWIN L. CONYER and WILLIAM J SCHWARTZ. *Surry*, 1947 22: 545.

A total of 24 patients were subjected to one or more operations for hallux valgus in the operating room of the outpatient clinic and then permitted to go home immediately by whatever transportation they could obtain. There were no complications. The results which were obtained were definitely better than those which had been observed in patients whose care had included 3 or 4 weeks of hospitalization with complete immobilization. These patients suffered minimal pain and all of them returned to the clinic walking surprisingly well and with an excellent range of motion in the metatarsal phalangeal joint. Local novocaine anesthesia was used.

In another series of 17 patients who were hospitalized for hallux valgus and bunions an additional 26 operations were performed. The patients who were operated upon under local anesthesia were encouraged to walk about their rooms immediately after the operation and were given bathroom privileges. Because of persisting anesthesia, they experienced no pain. In summary the author states:

1. The hallux should be splinted by means of corrective bandaging, without rigid fixation, following the operation. Multiple layers of bandage are essential if correction of the hallux valgus is to be maintained while ambulation is permitted.
2. Walking with full weight bearing is begun immediately when the operation is done under a local anesthetic, and on the day following the operation when it is carried out under general anesthesia.
3. The patient may be discharged from the hospital from 2 to 4 days after operation.
4. The original dressing should be changed and the sutures removed 24 days after operation.
5. The functional splinting by corrective bandaging should be continued for an additional 2 weeks.
6. Patients may be encouraged to resume their normal activities at the time that the bandaging is discontinued.
7. After bandage splinting is discontinued the foot should be soaked in warm, slightly soapy water for 30 minutes each day. While in the warm water the toe should be actively exercised.
8. Low heel, soft leather oxford shoes with a stiff shank, straight inside last, and metatarsal pads should be worn for at least 3 months.

C. FRED GORING, M D

Pseudarthrosis Resulting from the Use of the Intramedullary Nail of Kuntscher (Primo trattamento di terapia delle pseudartrosi col chiodo endomidollare di Kuntscher). PASQUALE DEL TORRE. *Gazz. Med. Ital.* 1947 31: 373.

The author presents a review of the history of internal fixation of fractures from 1886 to the advent

of the Knuetscher nail in 1940. He discusses the theoretical and practical advantages of the use of the intermedullary nail of Knuetscher. He also presents some of the disadvantages of this method in 4 case reports in which nonunion resulted. Three of these cases involved the femur and 1 case the humerus. These cases were reported as a warning against the optimistic trend of thought of some European and American surgeons in regard to this method.

CARLO SCUDERI, M D

FRACTURES AND DISLOCATIONS

The Olecranon Process. FRANCIS M. McKEEVER and RONALD M. BUCK. *J Am Med Ass* 1947 135:1

The removal of the fractured fragments of the olecranon process of the ulna is recommended when there is comminution of the fragments. This does away with the long healing process with considerable extra bone formation and usually involves some limitation of motion.

Total excision of the fractured fragments was carried out in 10 patients. In 7 patients there were old ununited fractures. The average restriction of flexion in the elbow in these 7 patients was 38 degrees. The average loss of extension of these same patients was 28 degrees. All of the patients experienced less pain after the operation and all of them had an increase in the range of motion of the elbow. The average improvement in motion was 57 degrees. Three patients believed that they traumatized their ulnar nerve more easily than before the excision of the olecranon. Stability of the elbow joint is dependent on the coronoid process and the distal vertical face of the ulna. If the fracture of the ulna is distal to the coronoid process the fragment should not be excised.

The operation consists of a 20 cm. curved incision over the olecranon. A wide dissection of the tissues is carried out the ulnar nerve is rerouted a transverse incision is made through the periosteum of the ulna distal to the site of the fracture and a flap is turned onto the triceps. The fractured fragments are excised from this flap. The sharp edges of the fractured bone are rounded the forearm is put into extension and the flap of the periosteum is drawn tight and sutured to the tissues of the forearm. A molded plaster splint is applied with the arm in moderate flexion for 3 weeks.

All patients were greatly benefited both subjectively and objectively. None had any instability of the elbow.

RICHARD J. BENNETT JR., M D

An Operation for Old Unreduced Bennett's Fracture. JOHN R. VASKO. *J Bone Surg* 1947 29 753

Three cases of old unreduced Bennett's fracture were treated by the suggested method. The greatest improvement following this procedure has been in the grip of the hand. In other cases in which the fracture was not reduced the grip has been materially weakened.

The operation is performed by making an incision over the dorsum of the base of the first metacarpal

the incision being carried down to the bone and the opponens pollicis and flexor pollicis brevis are then stripped off. Another small incision is made into the capsule. The small fractured fragment is located and two small drill holes are placed through the fragment. A third drill hole is made in the base of the metacarpal. The normal relationship is restored and the fragments are held in place by means of passing a No. 24 cotton suture through these holes. After closure a gauntlet type of cast is applied. The cast is left on for 4 weeks after which active motion is encouraged. The results are reported to be good.

RICHARD J. BENNETT JR., M D

ORTHOPEDICS IN GENERAL

Management of Hand Injuries. F H McC. CALLOW. *Med J Australia* 1947 2 349

Several factors contribute to unsatisfactory management of hand injuries. Little attention is given to teaching the subject in classroom lectures and in textbooks the injuries are often regarded as trivial, although from a functional viewpoint, fractures of the fingers may result in more disability than a fracture of the femur. A hand injury is a surgical emergency.

Examination of the injured hand calls for time and care. Every piece of skin should be saved if possible. The most common cause of crippling of the hand is scarring which always results when wounds granulate in. One should test for injury to the various individual nerves and tendons in every case.

Thorough cleansing of the hand and wound in the operating room under general anesthesia is of the greatest importance. After debridement of the wound and careful suture of severed nerves or tendons the wound must be closed if possible. If the skin edges cannot be drawn together the author recommends the use of a Thiersch graft immediately. Covering the wound in this manner promotes rapid healing and prevents infection, and the percentage of "takes" is high. In suturing the wound it is better to use too many rather than too few sutures. Fine needles and fine nonabsorbable suture material (silk, cotton, wire) are essentials. Skin hooks are preferable to forceps in handling the skin. Splinting is usually maintained for 3 or 4 weeks, but should be immobilize as few joints as possible. Nonsplinted joints must be used.

Rehabilitation of the injured hand is best accomplished by normal use, instituted as early as possible.

VERNON C. TURNER, M D

Management of Hand Injuries, Especially the Treatment of Injuries to Bones and Joints. LESTER J. WOODLAND. *Med J Australia* 1947 2 351

Mangled fingers and hands result in more permanent deformities and in far greater economic loss to the patient than major fractures of the long bones. Of all industrial accidents injuries to the wrist

hand and fingers account for one third of the number and about one-fifth of the cost. Of 50,000 injuries resulting in permanent partial disability 45 per cent involved the hand. Twenty-seven per cent of the hand injuries in industry cause some permanent disability. Roughly 1 in 4 of all hand and finger injuries become infected—a frequency 4 times greater than that found in injuries of other parts. Finger fractures cost about as much in compensation as do fractures which involve the long bones.

Solving the problem of hand injuries is like working a puzzle. If one factor is not correct, the puzzle is unsolved. In hand injuries and particularly finger injuries if one tissue—be it skin, tendon, ligament, bone or joint—is not restored, the result is partial or complete failure to prevent permanent disability.

Fractures of the bones of the hand usually heal in about 3 weeks, and the author believes that if fixation is removed earlier the position is apt to be lost and disability will result. Nonunion is very rare. Decalcification may result from reflex hyperemia due to pain or from infection. Fractures must be accurately reduced since the mechanism of the hand is intimately and compactly fitted together. Fingers splinted in extension will stiffen and full flexion of the other fingers will be impossible. Edema from whatever cause must be very actively treated, for fibrin will be deposited between all the tissues and produce fibrosis. Disease of the hand alone may cause edema. One must be a fanatic in the crusade against edema in order to secure good results. Occupational therapy of the remedial type is of greater help in rehabilitating the patient than routine physical therapy. Passive exercise should not be used in any of these cases.

If it is necessary to use traction (preferably through the pulp of the finger) it must be observed daily to see that it remains effective.

VENKOW C. TUDOR, M.D.

Correction of Retractions of Extremities by Slow, Bloodless Procedure (Corrección de las retracciones de los miembros por procedimientos lentos—no cruentos) JOSÉ M. JOROX and JOSÉ A. B. BÉLIZO. *Rev. Acad. argent. cir.* 1947 3:56.

Deformities of the extremities attributable to retraction of certain muscles, usually the flexors, and those caused by burns, paralysis of various origins (such as infantile paralysis) congenital myopathies and contractures which are sequelae of rheumatic polyarthritis may be of such severity that an operation is impossible or dangerous. In such cases a slow bloodless correction is recommended by the authors. Uninterrupted or intermittent traction may be applied. The authors usually employ skeletal traction being careful to use as little force as possible in order to avoid undesirable reactions.

Excellent results have been obtained in 3 patients. In the first, a young man of 19 years, a deformity of both hands and of the left lower extremity had been caused by a burn. The deformity involved both lower extremities in the second patient, a girl of 17 years, and was caused by infantile paralysis. In the third patient, a boy of 11 years, incomplete quadriplegia either of a congenital character or due to a myelopathy was present. In the last 2 cases the application of casts and conservative surgery in the form of tenotomies and osteotomies were supplemented by gentle traction. In this manner a rehabilitation of the patients was obtained.

JOSÉ M. JOROX, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

The Action of Heparin on Experimental Venous Thrombosis. LEO LEOWE, EDWARD HIRSCH, DAVID M. GRAYELL, and FLORENCE KASHDAN *Surgery* 1947 22 746

The authors, because of the variation of opinion as to the effect of heparin on preformed clots, elaborate upon the in vivo action of heparin on such clots. Heparin in vitro fails to exert any action on clots; heparin in vivo has on occasion resulted in disappearance of the clots. The recapitulation of previously recorded experiments was as follows: (1) if heparin was given previous to trauma and continued for a variable period afterward, thromboses were infrequently observed; (2) heparin administered up to 3 days after trauma caused disappearance of the clot in a considerable percentage of cases; (3) heparin administered when the clot was organized resulted in no demonstrable dissolution of the clot.

With the use of rabbits, the authors induced thrombosis in the jugular veins by mechanical means. After a variable control period one vein was removed from the rabbit for microscopic examination and then heparinization with a heparin Pitkin menstruum preparation was carried out for 6 to 14 days. The second jugular vein was then removed for study.

From this series of experiments the following conclusions have been drawn: (1) patency can be re-established in a number of experimental veins even as long as 6 days after a clinically visible and microscopically acceptable thrombus is present; (2) the extent and apparently the speed of recanalization is enhanced by the use of heparin; (3) when the vein is so occluded grossly as to preclude the resumption of clinical patency, recanalization is still greater in degree and extent under heparin therapy; (4) in the presence of occluded veins which cause definite obstruction to circulation, the opening of adjacent collateral venous channels is so extensive in the presence of heparin that the combined cross sectional area of the collateral system appears as great, if not greater, than that of the original vein.

EDWARD H. CAMP, M.D.

Post Thrombotic Sequelae of the Lower Extremity Treatment by Superficial Femoral Vein Interruption and Stripping of the Saphenous Veins (A Preliminary Report). ROBERT R. LINTON and IRAD B. HARDY, JR. *Surg. Clin. N. America* 1947 27 1171

The authors report a series of 34 cases of ulcer and edema of the lower extremity due to incompetence of the valves of the communicating and deep veins, which they treated by interruption of the long saphenous vein and stripping combined with interruption of the femoral vein distal to the junction of the profunda femoris vein. In every case the valvular

incompetence and circulatory defect was due to thrombophlebitis with recanalization, a definite history of thrombophlebitis being elicited in all but 3 cases. The Trendelenburg test performed with the tourniquet below the knee, revealed incompetent deep and communicating veins in all cases.

The authors describe the procedure and emphasize the necessity of determining venous pressures in the superficial femoral vein distal to a temporarily applied occluding ligature. Measurements are taken with the vein patent, with the vein occluded, and then with the long saphenous vein occluded, should the venous pressure exceed 30 cm. of water with both veins occluded, the operative occlusion of the femoral vein and ligation and stripping of the saphenous vein simultaneously are contraindicated. The authors believe that it is better in such a case to perform only one step of the procedure and to complete it at a later date when the venous pressure has fallen to more normal levels. Emphasis is also placed on the necessity of stripping the saphenous vein from its femoral junction to below the internal malleolus.

The results obtained were encouraging, with fallure of ulcer recurrence in all but 1 case, and improvement of edema in the majority of cases, as determined in a follow-up of from 2 to 14 months.

EDWARD H. CAMP, M.D.

The Therapy and Prophylaxis of Venous Thrombosis and Pulmonary Embolism. GORDON A. DONALDSON. *Surg. Clin. N. America*, 1947 27 1037

The therapy and prophylaxis of venous thrombosis and pulmonary embolism in the Massachusetts General Hospital, Boston, is producing results, as evidenced by an incidence of 3 fatal pulmonary emboli for every 1,000 operations there in 1945 as compared with slightly less than one per 1,000 operations in 1946.

Rational treatment of established thromboembolic disease may take one or more of three forms: the use of anticoagulant drugs, lumbar sympathetic block, or deep vein interruption. The use of heparin and dicumarol is based primarily on the prevention of the extension of thrombosis until such time as the established coagulum becomes more strongly organized to itself and to the vessel wall and until the patient is adequately ambulatory to insure a vigorous venous return. Lumbar sympathetic block rapidly and effectively increases venous return by interrupting reflex arterial spasm resulting from the irritating venous inflammatory process. Deep vein interruption performed above the level of the thrombosis precludes the further propagation of the thrombus and fatal embolism. Statistics of femoral vein interruption at the Massachusetts General Hospital are presented.

A controlled study in the prophylaxis of post-operative thrombophlebitis and pulmonary em-

bolism was carried out on comparable surgical services in the Massachusetts General Hospital during 1945-1946 the middle-aged patients in the study group receiving dicumarol routinely in the older aged group prophylactic superficial femoral vein interruption was carried out. The control group received no dicumarol and vein interruption was done in only a few instances in which patients developed recognizable thromboembolic disease. No fatal emboli occurred in the study group of 2,932 patients, while 6 fatal emboli occurred in the control group of 1,896 patients. The technique of the surgical procedure is outlined. EDWARD H. CAMP M.D.

Traumatic Arterial Vasospasm. PHILIP S. FOSTER.
N. England J. M. 947: 237, 1955.

This article is concerned not with the cases of subtotal ischemia in which immediate viability of a part is threatened, but rather with the larger group of traumatic cases wherein the persistence of low grade arterial spasm is likely to cause nutritional changes adversely affecting the functional result. The author contends that in many of these cases of low grade spasm, poor results can be avoided with rational specific therapy.

The incidence of arterial spasm does not parallel the severity of the original wound. Spasm is found more often with the smaller, quickly closed wounds, which suggests that tension is a factor. Injury to large arteries or nerves is not necessarily a part of the mechanism producing arterial spasm. A certain individual susceptibility is thought to be present. Diffuse tissue damage due to the concussive effect of explosive missiles is often a causative factor. The clinical picture includes local discomfort and resistance to function. The patient shows decreased surface temperature, blotchy cyanosis, and diminished peripheral pulses.

A penetrating low grade ischemia causes trophic changes that materially impair the functional result. Two cases of traumatic arterial vasospasm in which sympathetic block resulted in clinical improvement are presented. W. FOSTER MONTGOMERY M.D.

Surgical Cure of Innominate Aneurysm. HARRIS B. STUMACKER, JR. *Surgery* 947: 2, 1959.

Because of the few reported cases of surgical cure of innominate aneurysm, and because it presents such a difficult therapeutic problem, the author presents a report of the surgical cure of an aneurysm of the innominate artery in a soldier.

A summary is made of the 38 reported cases of attempted surgical treatment of innominate aneurysms, and essential points of analysis of these cases are selected as follows: (1) adequate exposure is essential, (2) hemorrhage at the time of operation or secondarily is the greatest attendant risk and commonest cause of death, (3) cerebral difficulties can be reduced to a minimum by repeated preoperative carotid compression, (4) the best surgical procedure from the standpoint of safety to the patient and likelihood of cure of the lesion is proximal and distal

ligation combined, when feasible, with excision of the sac or evacuation of its thrombus division and transfixion of the arteries rather than ligation in continuity is the procedure of choice, (5) for those cases involving the origin of the innominate artery wiring and coagulation, possibly combined with distal ligation, is probably the safest procedure offering the likelihood of a satisfactory result, (6) preoperative measures to increase collateral circulation are advisable.

EDWARD H. CAMP M.D.

The Clinical Behavior of Arteriosclerotic Aneurysm of the Abdominal Aorta: A Rational Surgical Therapy. ARTHUR H. BLACKBURN. *Ann. Surg.* 947: 26, 1955.

In a series of 35 cases of aneurysm of the abdominal aorta, reported from the Presbyterian Hospital, New York, the condition in 16 cases was due to arteriosclerosis, and in 6 cases, to syphilis. Vertebral erosion was noted in 4 of the patients with syphilis and in only 1 of the patients with arteriosclerosis. Aside from the fusiform nature of the arteriosclerotic aneurysms, a second factor was thought to be largely responsible for the rarity of the erosion, namely, elongation of the abdominal aorta. Angiostasis, with a buckling rather than a bending effect in the vessel, was noted in many specimens studied. This flexion angulation, the author thinks, may play a part in the development of the abdominal aneurysm. Because of the vertebral erosion and the pathology involved, the syphilitic patients showed a higher incidence and severity of pain. Attention called to the low incidence of pain and erosion with the sclerotic aneurysms. The appearance of deep-seated abdominal pain, low back pain, and pain radiating to the hips or legs, is a warning of impending disaster. Life-saving measures may be instituted even after signs of retroperitoneal hemorrhage.

The ideal surgical therapy for aneurysm entails cure with maintenance of blood flow through the affected vessel. This is accomplished by the electrothermic method herein described. Attempts to introduce a wire and induce clotting date from that of Moore in 1864. The author explains that the circulating blood exerts a pressure on the expanding aneurysm wall which varies with the square root of the surface area and the rate of blood flow. Clotting in turn offers the advantage of physical laws governing solids and usually clotting within the sac reduces the surface area to only that of a small area of the mouth of the sac. The rate of blood flow through the sac varies proportionately to the size of the mouth. The method of wiring and electrothermic coagulation is described in detail, and the method of determining and utilizing the rate of blood flow in the sac is explained. A technique with wiring is described for cure of fusiform aneurysm of the abdominal aorta and coagulation in conjunction with gradual endoarterial occlusion is described and discussed. Because of the factors tending to increase the incidence of aneurysm, this therapy is assuming more importance. W. FOSTER MONTGOMERY M.D.

Sympathectomy as an Adjuvant in the Operative Treatment of Aneurysms and Arteriovenous Fistulas. Sympathectomy Performed before or at the Time of Operation HARRIS B. SHUMAKER, JR. *Surgery* 1947 22 571

An experience with 303 cases of aneurysms and arteriovenous fistulas is reported. In the present series 290 patients were operated upon and 23 required no operative treatment because of cure of the lesions by thrombolysis. Seventy-eight sympathectomies were done before or at the time of operation. One additional sympathectomy is included in which the patient was thought to have an aneurysm, but proved to have costoclavicular compression of the subclavian vessels simulating the signs of aneurysm. Of these 79 sympathectomies, 34 were dorsal and 55 lumbar. No deaths and no serious complications occurred. Lumbar sympathetic ganglionectomies were performed under spinal anesthesia through an anterior extrapertoneal muscle-splitting incision. The upper extremities were denervated by the pre-ganglionic operation of Smithwick performed under intratracheal gas-oxygen-ether anesthesia.

The majority of sympathectomies were carried out in patients with lesions of the larger peripheral arterial stems. Sympathectomy was performed in 25 of 57 cases of popliteal involvement (44 per cent) in 11 of 25 cases of axillary lesions (44 per cent), in 17 of 53 cases of femoral aneurysm or fistula (32 per cent) in 3 of 11 cases of subclavian (27 per cent) and in 5 of 33 cases of brachial lesions (15 per cent). A few sympathectomies were done in instances of involvement of the innominate or common femoral arteries. In 12 of 107 patients with involvement of vessels other than those mentioned, sympathectomy was performed (11 per cent). Altogether 76 sympathectomies were performed in 290 cases in which operative treatment of the aneurysm or fistula was necessary (26 per cent).

Sympathectomy was done in a larger percentage of arterial aneurysms (34 per cent) than of arteriovenous fistulas (22 per cent). This was particularly true in lesions of the axillary, femoral and popliteal vessels. Although this difference is primarily a reflection of the tendency to poorer collateral circulation in instances of arterial aneurysm, it is partly dependent upon the fact that associated nerve infarcts requiring operative treatment were twice as common in cases of arterial aneurysms as in those of arteriovenous fistula. Forty-eight per cent of the arterial aneurysms operated upon involved the subclavian, axillary, femoral and popliteal arteries in 33 per cent of the arteriovenous fistulas there was involvement of these vessels.

Sympathectomy was done on 39 patients because of poor collateral circulation determined principally by the reactive hyperemia test of Matas. In a number of these patients, in addition to evidence of poor collateral circulation there were other reasons why it was deemed advisable to make every effort to render the collateral circulation adequate rapidly. These were associated peripheral nerve lesions requiring

operative treatment (41 per cent) severe pain pronounced vasospasm, superficial gangrene and rupture of aneurysm. There were 25 patients in whom the previously poor results of testing collateral circulation became satisfactory after sympathectomy.

In most instances the operation upon the vascular lesions closely followed the sympathectomy. In all but 2 cases, cure of the aneurysm or fistula entailed ligation of the affected artery. In the exceptions continuity of the artery was preserved or re-established by ligation of the fistula or by vein graft to bridge the arterial defect.

One case of a popliteal arteriovenous fistula is cited and excision of the fistula was first done 3 weeks after the sympathectomy. Gangrene resulted which required amputation of the distal third of the foot. There were 14 cases in which sympathectomy failed to render the tests for collateral circulation satisfactory however there was considerable improvement. In 1 patient a satisfactory cure by thrombolysis occurred making operation unnecessary and in 9 patients the continuity of the affected artery was maintained or restored by ligation of the fistula, end-to-end suture or by vein transplant. In only 4 cases was it necessary to ligate the involved artery. In all cases an excellent result was obtained. In those cases in which the continuity of blood flow through the affected artery was successfully maintained there was, in addition, no fatigue on exercise unless such fatigue had been present before operation. In all cases the color and warmth of the affected hand or foot was observed during a prolonged period of precise occlusion of the artery with a rubber-shod clamp at the time of operation and in all but 1 case this period of observation showed that the collateral circulation was actually adequate. In many of the cases some anatomic condition was found at the time of exploration which explained adequately the reason for the false results of the tests carried out before operation.

In 10 patients sympathectomy was done because of the impossibility of testing the collateral circulation preoperatively due to inaccessibility of the vessel. The aneurysms were arterial in 6 cases and arteriovenous in 4. The author believes that the procedure was definitely helpful in some cases it undoubtedly prevented cold sensitivity postoperatively.

In 6 patients sympathectomy was done because of vasospasm. This was believed to be definitely beneficial.

In 7 patients sympathectomy was done because of causalgia, ischemic lesions, and other conditions. In 2 the procedure was carried out chiefly because of causalgia. Both were improved.

In 7 cases sympathectomy was done needlessly because of error in localizing the lesion. However the results are listed as excellent, and the mistake appears to have been in localization of the lesions. It is pointed out the arteriography could have been very helpful.

Sympathectomy was performed at the time of operation upon the aneurysm or fistula in 9 patients

for various reasons, and was beneficial in all but 2 cases. In these there was evidence of ischemic paralysis postoperatively from which recovery was complete in one of the cases.

Consideration is given to the influence of sympathectomy upon the two commonest functional disorders which follow the ligation of arteries for the cure of aneurysms and fistulas, namely decrease in exercise tolerance and sensitivity of the limb to cold. A careful review of the exercise tolerance in patients having lower extremity lesions showed it to be the same regardless of whether sympathectomy had been performed. Sensitivity to cold of varying degree followed operation upon the subclavian axillary and brachial arteries in which ligation was necessary or in which reparative procedures failed to maintain continuity of the vessel, in 5 of 18 patients in whom sympathectomy was performed before or at the time of operation, and in only 1 of 32 cases of popliteal, femoral, or common femoral lesions treated similarly. Of these 6 patients, cold sensitivity was present before operation in 2. On the other hand cold sensitivity was present after operation in 13 of 42 patients treated for lesions of the subclavian axillary and brachial vessels without sympathectomy and in 5 of the 65 patients with popliteal, femoral, or common femoral lesions. Eight of these 18 patients had some cold sensitivity before operation. Among those patients operated upon elsewhere, sensitivity to cold was present in 5 of 11 patients with aneurysms or fistulas of the main arteries to the upper extremity and in 9 of 30 with lesions of the main arteries to the lower extremity. Altogether 13.7 per cent of those 51 patients sympathectomized before operation upon the vascular lesions had sensitivity of the limb to cold.

Not infrequently sympathectomy was followed by a noticeable increase in the mural thrombus within the aneurysmal sac. Spontaneous cure occurs occasionally without sympathectomy in cases of both arterial aneurysm and arteriovenous fistula. This occurred in 11 of 225 cases studied. On the other hand "cure" by thrombosis occurred in only 2 of 78 patients sympathectomized; an incidence of 2.6 per cent. Thus it is difficult to be certain that the thrombosis is actually the result of the sympathectomy. The hypothesis offered by Gage, that the responsible mechanism is the decrease in peripheral resistance appears the most explanatory. In 1 case there appeared to be distal extension of the clot in a patient with an arteriosclerotic aneurysm of the popliteal artery.

LEROY J. KLEINERMAN, M.D.

Sympathectomy as an Adjuvant in the Operative Treatment of Aneurysms and Arteriovenous Fistulas. Sympathectomy Performed after Operation. HARRIS B. SHUMAKER, JR., *Surgery*, 1947 21: 597

The clinical material consists of 290 patients who were operated upon for aneurysms and fistulas, 13 patients in whom a satisfactory cure by thrombosis occurred and an additional 63 patients who had been

operated upon by others. Sympathectomy was done before or at the time of operation upon 76 of the 290 patients, and upon 1 of the 63 patients who had been operated upon by others and it was carried out in 2 of the 13 patients in whom a cure by thrombosis subsequently occurred. Sympathectomy was performed after operation in 19 of the first group and in 18 of the second. Sympathectomy was also done subsequently in one patient who had had a spontaneous cure.

The chief indications for operation in 39 cases were as follows:

1 Sensitivity of the limb to cold. There were 17 patients in this category: 9 had arterial aneurysms and 8 had arteriovenous fistulas. All the patients had annoying coldness of the affected hand or foot upon exposure to cold and most of them had cyanosis. All had discomfort during such exposure and the majority had some degree of numbness of the fingers or toes, and nearly all complained of stiffness of the fingers or toes. Increased resistance to cold was tested with sympathetic procaine anesthesia. Eight patients had associated peripheral nerve lesions. All but 2 patients obtained complete relief from cold sensitivity and definite improvement occurred in these.

2 Associated paralysis and impaired circulation. In 5 patients sympathectomy was performed in an attempt to improve impaired circulation, in order to afford maximal opportunity for repair of extensively damaged peripheral nerves. Improvement occurred in all cases. It was notable that in those cases in which it was thought the pressure of the aneurysm was partially responsible for the pain there was little improvement by merely operating upon the aneurysm.

3 Persistent edema. Six patients were operated upon for this reason. All had failed to improve under conservative measures and sympathetic block gave only temporary or no relief. In all there was improvement.

4 Ischemic lesions, causalgia, and other conditions. There were 11 patients in this group and in all the treatment by sympathectomy was beneficial.

LEROY J. KLEINERMAN, M.D.

BLOOD TRANSFUSION

Hemophilia: A Report of the Mechanism of the Development and Action of an Anticoagulant in 2 Cases. CHARLES O. CRADOCK, JR., and JERRY S. LAWRENCE. *Blood* 1947 2: 505.

Two cases of hemophilia are presented in which the development of a circulating anticoagulant was detected. This anticoagulant was demonstrated in the whole blood plasma, and serum in both cases. One of these cases has been previously reported by Lawrence and Johnson and a similar one was reported by Munro and Jones in 1943. Munro and Jones suggested that numerous transfusions are responsible for the development of this anticoagulant. Munro later showed by plasma fractionation that the anti-

coagulant activity was associated with the globulin fraction of the plasma, this is the gamma globulin fraction. Lawrence and Johnson found it to be heat stable and nondialyzable through colloidion.

Both of the authors' patients became refractory to treatment with either fresh whole blood plasma, or antihemophilic globulin (Fraction 1 of Cohn). In fact, the anticoagulant apparently made its appearance as a result of repeated transfusions or injections of antihemophilic globulin. The authors showed that antithromboplastin was not present in enough strength to explain the anticoagulant activity of the patient's blood. The anticoagulant in each case was shown not to inhibit any of the elements participating in the classical theory of clotting, i.e. prothrombin, thromboplastin, thrombin or fibrinogen. It was also demonstrated that this anticoagulant was not related to heparin in its mechanism of action.

Electrophoretic fractionation of the plasma was carried out and it was found that the anticoagulant was associated with the gamma globulin fraction of plasma. The demonstration of specific precipitin titers in the serum of each of these patients against antihemophilic globulin seemed to indicate that the mechanism of action of the anticoagulant was to inhibit the action of antihemophilic globulin. This was further substantiated by the in vitro inhibition of the ability of antihemophilic globulin to accelerate the coagulation time of ordinary hemophilic blood.

A hypothesis is presented to explain the appearance of the anticoagulant. It is believed that these 2 hemophiliacs are deficient in or lack antihemophilic globulin in their blood and hence repeated injections of the globulin either in the form of whole blood plasma, or Fraction 1 of Cohn resulted in 'isomunization' against the injected globulin. The resulting antibodies inhibited any antihemophilic globulin which may then have been injected which explains the refractory state exhibited by these 2 cases. Blood from these patients containing these antibodies likewise exerted an anticoagulant influence when added to normal blood by the same mechanism.

It is significant that the transfusion of washed red cells resulted in improvement in both of these cases.

LEROY J. KLEINWASER, M.D.

Studies on the Enigma of the Hemostatic Dysfunction of Hemophilia. ARMAND J. QUICK and WILIAM F. STAFF. *Am. J. M. Sc.* 1947 214 273

The deficient factor in hemophilia is thromboplastin. Gradually evidence has been accumulated that the deficient factor in hemophilia resides in the plasma rather than in the platelets as formerly thought. Fundamentally it is shown that the defective hemostasis of hemophilia is due to a lack of available thromboplastin in the blood. The prothrombin is normal both qualitatively and quantitatively but because of the lack of thromboplastin in hemophilic blood, little prothrombin becomes converted into thrombin. This is shown to be a fact as little prothrombin is consumed in the coagulation of hemophilic blood. It is emphasized that the de-

termination of the consumption of prothrombin offers the first promising means for assaying the thromboplastic activity of the blood. Normal plasma contains enough available thromboplastin to convert from 80 to 90 per cent of the prothrombin to thrombin. By giving a hemophilic patient a plasma transfusion enough thromboplastin can be supplied to maintain effective hemostasis for 24 to 48 hours.

The coagulation time is of limited value as a measure of hemostatic effectiveness particularly as a guide to the prothrombin level. In the case of hemophilia the coagulation time is a somewhat better guide but unfortunately even in this condition a temporary reduction of the clotting time to normal does not necessarily assure good hemostasis.

The results obtained in the present investigation clearly show that the platelets are essential for coagulation since they appear to be required for the activation of the thromboplastin which is present in the plasma in an inactive form. It appears that on disintegration the platelets liberate an enzyme which acts specifically on the precursor of thromboplastin, thromboplastinogen. Hemophilic platelets would thus be normal in function but have no thromboplastinogen to convert. As soon as this material is supplied by the transfusion of normal plasma, the hemophilic platelets react and daily normal coagulation is established.

The agglutination and disintegration of platelets appear to be contingent upon the formation of thrombin. In hemophilic blood in which the production of thrombin is minute, the platelets remain unaltered. This suggests that the production of thrombin is related to platelet disintegration and it may well be that the following chain reaction is set up: formation of thrombin brings about the disintegration of platelets, which in turn makes more thromboplastin available to form more thrombin. The coagulation of normal blood which is characterized by a latent period followed by rapid conversion of fibrinogen to fibrin strongly suggests such a chain reaction.

LEROY J. KLEINWASER, M.D.

Denatured Calf Plasma for Transfusion. J. MILKA, V. RAPANT and B. ZAPLETAL. *Lancet* Lond., 1947 3 382.

To replace human plasma for transfusion calf plasma must have its antigens removed. Such plasma without its antigens is called denatured calf plasma (D.C.P.) by the authors. To remove the antigens the calf plasma is treated with formal and heat. A change in the appearance of the calf plasma during this process (it becomes opalescent when viewed against a dark background) is important in the proof that the plasma has been denatured. The denatured calf plasma is then refrigerated in sterile containers, and it lasts almost indefinitely.

The author's laboratory research proved the following facts:

1. Denatured calf plasma does not contain agglutinins for human blood corpuscles of groups A, B or AB.

2. It never hemolyzes human red corpuscles.
3. It does not produce precipitates against the proteins of denatured calf plasma or of natural calf serum in guinea pigs, rabbits, or in the human being.

4. With denatured calf plasma we cannot sensitize guinea pigs so as to produce anaphylactic shock after the injection of calf serum or denatured calf plasma. The authors confirmed Masson's work as to the harmlessness of infusions of denatured calf plasma.

Blood and plasma are more valuable than saline infusions in combating shock because of their colloid osmotic proportion. The authors demonstrated that the denaturing process does not reduce the colloid osmotic pressure of the denatured calf plasma proteins. They also showed that denatured calf plasma is not excreted in the urine even after repeated administrations.

The authors believe that the incidence of intolerance in blood transfusions, which intolerance occurs despite every precaution, can be reduced by the use of denatured calf plasma. However the chief advantage of denatured calf plasma is its easy availability and low cost. Transfusions of this substance are recommended whenever there is a shortage of blood donors and whenever it is preferable to give plasma instead of whole blood.

JAMES WEAVER, M.D.

MISCELLANEOUS

The Origin and the Physiology of Heparin; The Specific Therapy in Thrombosis. J. ERIC JORPES. *Ann. Int. M.* 947 7 36

Heparin is a mucopolysaccharide resembling the chondroitin sulfuric acid of cartilage. The strongest samples contain 36 per cent of a uronic acid and about 23 per cent of glucosamine. These components make up 90 per cent of the organic structure of heparin. Heparin contains ester sulfuric acid not only one group to each disaccharide unit but three groups, which make up not less than 45 per cent of the weight of the free acid. The uronic acid in heparin is claimed to be glucuronic acid. It is unknown whether heparin contains an acetyl group. There is no free NH_2 group. Acetic acid cannot be obtained from heparin except in much smaller quantities than would be calculated. The amount obtained by ordinary methods might come from impurities. It is unknown whether heparin is a definite chemical compound or whether it is a mixture of disulfuric and trisulfuric acid esters of one and the same polysaccharide, having a composition similar to that of Karl Meyer's hyaluronic acid. All types of polysaccharides acquire anticoagulant properties if thoroughly esterified with sulfuric acid. Heparin has a high molecular weight and carries an exceptionally strong negative charge. The high content of ester sulfuric acid is the outstanding feature in its structure. The anticoagulant activity is probably exerted through the electric charges of the high molecular polysaccharide.

Heparin acts on the components of the coagulation system—on the thrombin prothrombin and the

thrombokinase. It neutralizes the serum complex interfering with the Wassermann reaction. In higher concentration it influences the sedimentation rate through the plasma proteins. Its multiplicity of action is probably an expression of the effect of the acidic polysaccharide on different proteins. The interaction of heparin and thrombin is easily reversible. Protamine instantly abolishes the heparin effect by neutralizing its negative electric charge. Protamine sulfate from 50 to 100 mgm., can be injected intravenously in man in 1 per cent solution and brings the coagulation time instantaneously down to normal. Various animal heparins with the same content of ester sulfuric acid have various anticoagulant strengths—a fact difficult to explain. In spite of a strong ionic dissociation heparin exerts an extremely low osmotic pressure in aqueous solution. This is a protective mechanism whereby heparin-producing cells are protected from disruption by water flowing to establish osmotic equilibrium. This also makes heparin useful in blood analysis because it does not cause red corpuscles to shrink.

Heparin gives an extraordinary strong purple violet stain with certain blue basic dyes. One of these is toluidine blue which stains only high molecular esters of sulfuric acid a purple violet. The mast cells stain in this way with toluidine blue. They have a characteristic perivascular position. They are able thus to void their granular contents almost directly into the blood stream. They follow the capillaries and are thus rich in inflammatory tissue. Among the victims of Hiroshima, who showed a general bleeding tendency, there was a general increase in the mast cells in their tissues. Hyperheparinemia has been produced with an increase in mast cells by irradiation in dogs. Urticaria pigmentosa with multiple petechiae in the skin is a disease with abnormal accumulations of mast cells in the skin. It is now known that the mast cells produce heparin.

Heparin is clinically used in cases of thrombosis to influence the coagulation time. It can be used postoperatively to prevent thrombosis and embolism. Prophylactic use of anticoagulants is made difficult by their expense and by the tendency of patients to bleed from their operative site. However they should be used postoperatively or after childbirth when there is a previous history of thrombosis. The author cites data showing that heparin shortens the course of thrombosis of the leg and decreases the incidence of later complications, such as edema. Heparin effects need not be checked by blood analysis except in special cases—as in elderly people with impaired renal function. Heparin and dicumarol often have quite a specific effect in protracted non-viral pneumonias which are resistant to antibiotics. Latent pelvic thrombosis producing pulmonary emboli is more common in these cases than is suspected. Anticoagulants will be useful in preventing clotting in the capillaries in various diseases. The author cites a case wherein heparin cleared up an anuria following a transfusion of incompatible blood.

JAMES WEAVER, M.D.

The Use of Dicumarol as an Anticoagulant; Experience in 2,397 Cases. EDGAR V ALLEN, EDGAR A. HINES, JR., WALTER F KYALL, and NELSON W BARKER. *Ann. Int. M.* 1947 27 371

The expert use of the anticoagulants heparin and dicumarol has improved tremendously the outlook for patients who have acute vascular thrombosis.

An over-all consideration of 1513 postoperative patients treated with anticoagulants indicates that the following results were achieved

Eighty-five patients survived who would have been expected to die from pulmonary embolism 250 patients were spared venous thrombosis or nonfatal pulmonary embolism. In 506 additional postoperative cases in which dicumarol was used prophylactically venous thrombosis occurred in but 2 instances there was no pulmonary embolism.

A consideration of 208 medical patients indicates that fatal pulmonary embolism was prevented by anticoagulants. Nonfatal pulmonary embolism and venous thrombosis occurred very infrequently. A study of 50 cases of acute myocardial infarction in

dicates substantial reduction in the incidence of further myocardial infarction and in arterial embolism and venous thrombosis. Survival of the extremity occurs in 91 per cent of cases of arterial embolism and in 81 per cent of cases of arterial thrombosis if treatment with anticoagulants is begun early and supplemented by other treatment.

Our experiences indicate clearly that the anticoagulants are effective in the treatment and prevention of vascular thrombosis of medical patients just as they are effective in the care of postoperative patients with these conditions. Fatal pulmonary embolism can be prevented and venous and arterial thrombosis can be halted in most instances. Early treatment of sudden arterial occlusion with anticoagulants and other measures results in survival of the extremity in 90 per cent of instances of embolism and 80 per cent of instances of thrombosis.

In general the use of anticoagulants constitutes the greatest contribution to the successful treatment and prevention of intravascular thrombosis and embolism.

SURGICAL TECHNIQUE

OPERATIVE SUROERY AND TECHNIQUE POSTOPERATIVE TREATMENT

Intravenous Oxygen and Pulmonary Embolism.

JACK H. SANDERS and LEONORE M. JONES. *Ann Surg* 947 136 208.

Because of the controversial state of reports in the literature on intravenous oxygen administration for the treatment of shock, the authors have made a study of the effects of the administration of intravenous oxygen on 2 patients in shock and on 4 patients who were observed to be in a fairly stable cardiorespiratory condition. One experiment was done with the use of 50 c.c. of venous blood drawn from a dog and by noting the oxygen saturation produced in vitro. Studies showed that after the passage of oxygen bubbles through venous blood at rates comparable to intravenous administration, the blood failed to show any appreciable absorption. The authors concluded that gas bubbles coalesce in the veins become of considerable diameter by the time they reach the pulmonary arteries and may occlude the smaller arteries. The resulting gaseous embolism causes a decreased pulmonary circulation arterial hypoxemia and systemic hypoxia, and these effects probably are intensified by reflex pulmonary spasm and bronchospasm. The authors state also that the present status of intravenous oxygen as a therapeutic measure is doubtful and because of the possibility of pulmonary embolism, is hazardous. It is thought that some of the ill effects of pulmonary gaseous embolism might be alleviated by the administration of atropine and papaverine before intravenous oxygen is given. A state of shock or of anesthesia may also diminish these reflexes.

W. FOSTER MONTGOMERY, M.D.

Clinical Evaluation of Bovine Serum Albumin as a Blood Substituta. DAVID STATE, FELIPE TORRES ROMERO, MANUEL MORENO CASTELLANOS, and OWEN H. WANGENSTEEN. *Surgery* 947 1 424.

The authors made use of highly purified bovine serum albumin fractions obtained by the precipitation of bovine plasma by ethanol alcohol at 5 C. Four hundred and sixty-nine injections were made into 410 patients with 12 (2.9 per cent) immediate reactions and 38 (9.2 per cent) delayed reactions. There was therefore a marked reduction in the incidence of immediate and delayed reactions attending the use of purified bovine serum albumin fractions.

The immediate reactions were of 2 types (1) The anaphylactoid, which was characterized by dyspnea, cyanosis, and fall in the blood pressure, and (2) the pyrogenic, characterized by chills and fever. In the main, the reactions were moderately severe. The onset of the delayed reactions was usually from 12 to 4 days after the injection and was characterized by ticaria, erythema, myalgia, arthralgia, and fever.

In the severe cases, there were petechiae and ecchymoses. The incidence of both immediate and delayed reactions was no greater in patients who received multiple injections than in those who received a single injection.

Procalcine given intravenously (1 gm. in 100 c.c. of saline solution over an interval of one hour) is a very effective agent in the treatment of delayed serum sickness. In concentrated solutions (15 per cent), bovine serum albumin would appear to be an effective agent in the prevention and treatment of shock. For a large blood loss (in excess of 80 c.c.) blood obviously would be a more satisfactory agent with which to combat shock. Because of the persistence of and incapacity caused by the delayed reaction, crystallized bovine serum albumin is not recommended at present as an ideal blood substitute.

C. FRED GORDON, M.D.

Changes in Plasma Volume and Mean Arterial Pressure after the Intravenous Injection of Concentrated Human Serum Albumin in 21 Patients with Oligemia and Hypotension. ALICE LOWELL, ANNE COUDREMAN, and DUDMAN W. RICHARDS, Jr. *Surgery* 1947 221 442.

The authors have studied the intravenous use of concentrated human serum albumin to determine the efficacy of this agent in assisting the recovery from shock and shocklike conditions. The present article is concerned primarily with a comparison of the effects upon mean arterial blood pressure and plasma volume of the intravenous injection of concentrated human albumin solutions when given with or without additional intravenous fluids.

It was determined that the intravenous administration of concentrated albumin solution with or without additional fluid, was free from untoward clinical reactions as evidenced in two groups of patients (18 in one group and 30 in the other) one receiving concentrated albumin without, and the other receiving concomitant solution with, additional fluid. The injection of concentrated human solution alone (without concomitant saline solution) was associated with an immediate increase in plasma volume of about 15 c.c. per each gram of albumin injected and retained, and a fall in the hematocrit. Since the expected in vitro value is 18 c.c. per gram of albumin, it appears that the albumin retained did not hold a volume of fluid commensurate with its theoretic osmotic activity. However the intravenous injection of 400 c.c. of isotonic saline solution along with the albumin resulted in a somewhat greater increase in plasma volume per gram of albumin both injected and retained the average being 16 c.c. which compares more favorably with the theoretic value of 18 c.c.

Patients in severe shock, presumably with continuing blood or plasma loss (burn or peritonitis)

showed much smaller increases in plasma volume per gram of albumin given and retained namely an 8 c.c. average in shock against a 14 c.c. average in nonshock patients.

The administration of 100 c.c. of concentrated albumin (25 per cent) without additional fluid corresponds to about 200 c.c. of plasma.

In 25 per cent of the cases studied the total circulating protein after the injection of albumin was significantly greater than expected. This increase suggests the possibility that during recovery protein may be mobilized from body reserves or that blood in static pools during the hypotensive period may be returned to the circulating blood as the general circulation improves.

There was noted a rise in intra-arterial blood pressure (average 17 mm. of Hg.) in both groups of patients but the blood pressure failed to reach accepted normal levels. Hemodilution with its decrease in blood viscosity may account, at least in part, for the failure of the blood pressure to rise to accepted normal levels. A stationary or falling blood pressure with a rapid increase in plasma volume after the intravenous injection of albumin may indicate failure in vasomotor tone. ROBERT TURELL, M.D.

The Use of a Mixture of Pure Amino Acids in Surgical Nutrition SIDNEY C. WERNER, *Ann. Surg.*, 1947 126 169.

A careful clinical study was made with a metabolism ward set up at the Presbyterian Hospital, in New York. The authors concluded that the healthy adult remains in nitrogen equilibrium except for minor daily fluctuations. Their data indicates that no excesses of nitrogen appear in the urine when nitrogen is withheld postoperatively and that the nitrogen excretion may be less than that of an injured patient on the same intake. High carbohydrate regimens spare nitrogen, which would be unlikely if the nitrogen loss were the result of toxic destruction of tissues, as suggested by others. It was thought that there was no increased rate of catabolism or tissue destruction in the absence of nitrogen intake. Contrary to the anabolism theory the authors believe that the incoming nitrogen is not entirely wasted and a high nitrogen intake lessens or reverses negative nitrogen balance after trauma. The authors assume that there is an increase in the rate of both anabolism and catabolism.

The use of protein hydrolyzates for parenteral nutrition has been shown to have certain practical difficulties. A satisfactory protein substitute is still desirable and a mixture of pure amino acids, "VUJ" was given clinical trial. This mixture of pure amino acids in 10 per cent and 8 per cent solution was used clinically. Seventy three patients received the 8 per cent solution which seemed the more satisfactory. Few toxic effects were noted with the 8 per cent solution. In the series, only 1 death of obscure origin was reported. It was feasible to give up to 1,500 c.c. of the amino acid solution twice daily to provide 28.8 gm. of nitrogen.

For evidence of increased catabolism if nitrogen has not been given after the injury the authors include three conditions which are necessarily present in addition to injury, namely, the presence of incoming nitrogen inanition and severity of injury.

Twenty patients with peptic ulcer and 1 patient with lymphoma of the stomach were submitted to partial gastric resection and given the pure amino acid preparation during the postoperative period. A similar series of 29 cases served as controls. A fifth of the controls appeared to do less well than the amino acid treated patients. It was pointed out that the results in the two groups were similar enough to suggest that possibly unconsidered postoperative therapy with amino acids may be unnecessary. Clinical benefit criteria were tabulated. Complications and the length of hospital stay were thought lessened with the administration of amino acids. The return to normal temperature after operation appeared sooner. Abdominal distention and postoperative edema of the stoma showed a higher incidence without treatment. The treated patients appeared to be stronger than the controls. Appetite and ability to eat a bland diet may have been improved with amino acid therapy.

W. FOSTER MONTGOMERY, M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Frostbite. KURT LANGE, DAVID WEINER, and LYNN J. BOYD *N. England J. Med.*, 1947 237 383.

The physiology of frostbite is characterized by blanching followed by a pinkish discoloration of the involved part. The thawing phase further intensifies the discoloration, to which is added swelling and temperature elevation. During this period blister formation is pronounced and is rapidly followed by vesicle rupture. If the blister fails to rupture it forms a dense gelatinous adherent mass on a red inflammatory base. Sensation to pin prick, heat, and cold is lost. Within a period of 3 to 10 days well demarcated areas of gangrene appear. The intravenous injection of fluorescein during the acute phase of frostbite in the experimental animal is characterized by a total absence of fluorescence. During the thawing period hyperfluorescence is marked because of the increased blood flow and capillary permeability. This is followed again by another phase, 48 to 140 hours after cooling during which the part is completely nonfluorescent as a result of vascular occlusion and the onset of gangrene. Microscopy of the capillaries reveals the clumping of circulating red cells as the basic phenomenon of vascular occlusion. During the thawing period the cell masses break up and the red cells resume their independence. When this fails to occur the agglutinative thrombi of red cells may undergo complete hyalinization after from 3 to 8 days. The escape of plasma protein into the interstitial spaces is followed by fibrinization of the clot with subsequent fibrosis and collagen formation described as lardaceous inflammation.

Animals subjected to cooling experiments and heparinization failed to develop gangrene, whereas all the animals in the control group developed gangrene under similar conditions. Of great significance in the former group was the absence of agglutinative thrombi and hence the inhibition of gangrene by heparinization. A series of similar experiments were made on human volunteers.

The following tests were made the effect of topical freezing, freezing with immediate heparinization, heparinization delayed for 24 hours after freezing, interim cooling and interim warming combined with heparinization. Untreated freezing caused gangrene. Immediate and early heparinization gave the best therapeutic results, the hilster fluid did not clot and fibrosis did not develop. Interim cooling and warming created a more intense type of gangrene than that caused by freezing alone. Recommended for the treatment of frostbite is the intravenous administration of a total of 300 mgm. of heparin in 2,000 c.c. of normal saline for a 24 hour period delivered at the rate of 20 to 25 drops per minute. Heparin in Pitkin's menstruum is not recommended because of pain associated with its injection. Clotting time is checked by the Lee and White method at 12 hour intervals with blood coagulation maintained between 30 to 60 minutes. Treatment should be maintained for 6 to 7 days. Resulting surgery is limited and conservative.

BENJAMIN G. P. SHAPIROFF, M.D.

Grafts of Skin and Cartilage. JAMES BARKETT BROWN, BRADYDOR CAMPOS, CARL E. LISCHKE, and W. BOWDOEN DAVIS. *J. Am. M. Ass.* 947:134, 95.

Composite free grafts from the ear comprising two surfaces of skin with cartilage between have proved increasingly useful in the replacement of tissue lost from the nasal tip, nostril borders, and columella. The use of free transplant has made it possible to perform repairs in a single procedure with minimal deformity to the ear and has eliminated the need of multiple procedures in moving distant flaps.

The length of the graft is not limited but it is doubtful whether grafts over 1 cm. in width can be successfully transplanted. The columella, tip and one ala of the nose can be restored with a single graft. To correct a short ala, the alar scar can be opened and a wedge-shaped graft inserted or a constricted nostril due to a burn can be opened by excision of the scar and repaired with a composite graft. Adequate minute blood supply with as much well vascularized surface as possible available for contact between the nose and the graft is necessary in preparation of the defect for the graft.

A pattern of the final defect is helpful in selecting a suitable part of the ear for the donor area and accurate measurement of the graft.

Portions of the normal ear with thin skin over the cartilage are best. If a long or wide graft is necessary the rim of the helix is the only possible source. Separation of cartilage from skin should be avoided. Repair of the ear in large excisions requires a scalp

flap in which the open ear is buried. Smaller excisions can be repaired by direct closure or by local flap and graft.

The graft is accurately sewed in place. In dressing, adequate immobilization is secured by padding the nostrils and applying gentle but firm external pressure.

LOUIS T. BIRAR, M.D.

Acute Subpectoral Abscess: A Surgical Emergency. KNOWLES B. LAWRENCE and THOMAS J. ANDERSON. *N. England J. M.* 1947:37:390.

Expectant treatment and delay in the surgical treatment of subpectoral abscess may lead to extensive tissue destruction and axillary abscess. More serious complications such as subscapular space infection, empyema, mediastinitis, and septicemia may develop. Sulfonamide therapy and other antibiotics are only delaying in action, whereas early surgical drainage is essential in all cases.

Subpectoral abscess is characterized by a ribbed infection of the upper extremity leading to suppurative infection of the infraclavicular lymph nodes located along the subclavian and axillary vessels lateral to the anterior scalenus muscle. Suppuration may extend through the axillary fascia, the fascia of the axillary space, or may follow the vascular pathways to the arm or mediastinum. Relatively high pressures may develop in the subpectoral space before rupture occurs into the surrounding fascial spaces. Edema of the overlying muscles contributes to the swelling of the area and the severity of the pain. The primary focus is frequently an insignificant infective lesion of the middle finger, a lesion on the chest wall, or in the shoulder area.

Clinical manifestations consist of pain in the shoulder area that progresses in intensity and motion becomes limited and painful. If the infecting organism is the streptococcus the patient is usually ill and toxic. Tenderness and swelling is present in the subpectoral region, the shoulder, the axilla, and the supraclavicular fossa. Signs of fluctuation cannot be elicited until late, when the suppurative process has ruptured through the axillary fascia. Differential diagnosis involves the shoulder joint and its bursae.

Treatment should be directed at early incision and drainage of the subpectoral space even in the absence of frank suppuration. The incision should be made in the axillary fascia at its line of fusion with the lateral margin of the pectoralis major muscle. The skin incision is made at right angles to the anterior axillary fold. After exposure the forefinger is used for blunt dissection high up into the space as far as the anterior scalenus muscle and the axillary structures. Counter incisions may be made to secure dependent drainage.

BENJAMIN G. P. SHAPIROFF, M.D.

Streptomycin Therapy in 52 Cases of Bacterial Infection. LEWIS W. KANE and GEORGE E. FORT. *N. England J. M.* 947:337-33.

The authors report 52 cases of bacterial infection treated with streptomycin. Urinary infections, b-

cluding 38 cases of pyelonephritis and 1 case of cystitis, made up the bulk of the cases. All of the infections were due to the gram negative bacilli and were treated with intramuscular streptomycin given on a 4 hour schedule. The total daily dose ranged from 0.5 to 2 gm. and was continued for 3 days after the urine became sterile. Most important, because of the fact that streptomycin is most effective in an alkaline medium the urine was alkalinized in the majority of the cases. One teaspoonful of a 50 per cent solution of sodium citrate 3 times a day was usually sufficient. In the presence of pulmonary or peripheral edema potassium salts were substituted for sodium citrate. Thirty of the 40 patients with urinary infection had sterile urine for 1 week after therapy was discontinued and were considered to be cured. Only one questionable relapse was found in this group. Moderate structural damage, such as dilated calyces, slight hydronephrosis, partial stricture of a ureter or small nonobstructing calculi did not seem to preclude a cure if the infecting organism was sensitive. The authors attribute their better results as compared to those reported by other workers to the alkalization of the urine.

In addition 3 patients with nonspecific urethritis were given streptomycin therapy with good results. Four patients with Haemophilus influenzae infections were likewise treated with excellent results. In the 2 cases of Haemophilus influenzae meningitis from 0.05 to 0.1 gm. of streptomycin was given intrathecally. Three patients with bronchiectasis were treated with streptomycin and penicillin aerosol but only 1 patient was thought to have been benefited. A case of lung abscess due to Haemophilus influenzae showed marked improvement under this therapy and recovery of a patient with Pseudomonas aeruginosa septicemia was effected.

F J LIEKMANN JR. M.D.

Polymyxin: A New Chemotherapeutic Agent P G STANLEY, R G SHEPHERD and H J WHITE. *Bull Johns Hopkins Hosp* 1947 81: 43

Polymyxin is a new antibiotic substance derived from the *Bacillus polymyxa*. Its potency is assayed as that unit of activity which is equivalent to the amount of polymyxin per milliliter which just inhibits the growth of *Escherichia coli* MacLeod strain. Polymyxin is a white, water soluble powder with a pH of 5 in aqueous solution. It is relatively stable in dilute acid alcohol solutions and to heat. Also, it is not affected by prolonged incubation with pepsin, trypsin or pancreatin.

In vitro by the agar streak method from 0.5 to 16 micrograms of polymyxin per milliliter inhibit 56 of 64 strains of gram negative bacteria. This antibiotic is particularly effective against virulent strains of *Klebsiella pneumoniae* or *Pasteurella multocida*. A single dose of 10 micrograms per 20 gram mouse is sufficient to protect practically all the inoculated mice against the *Klebsiella pneumoniae*. Chickens injected with a fatal strain of fowl typhoid can be protected by the daily injection of an average

of 16 mgm. of polymyxin per kilogram of body weight.

Polymyxin is effective subcutaneously and intravenously. For oral potency the drug must be increased to 64 times the parenteral dose. The formaldehyde bisulfite derivative of polymyxin causes no local irritation, even when injected in 15 per cent solution. It is not toxic, even when injected in 100 milligram doses for a period of 30 days.

BENJAMIN G P SHANTOFF M.D.

ANESTHESIA

Skin Temperature as a Clinical Aid during Anesthesia J CLUTTON-BROCK. *Proc R Soc Med Lond* 1947 40: 607

Skin temperature readings are used to distinguish between falls in the blood pressure which are due to shock and those which are due to other causes of little significance. The combined fall of skin temperature and blood pressure readings predict the patient's need for resuscitation.

A mercury in glass thermometer is used which reads from 80 to 170° F. The ring bulb is attached by elastoplast to the patient's forehead and changes in temperature rather than absolute readings are considered to be of significance. After an initial rise during the induction of the anesthesia, the temperature of the skin will remain steady unless shock occurs. A fall of 3 degrees or more is believed to show a considerable degree of shock. A marked fall in blood pressure can occur without a fall in skin temperature when the low blood pressure is due to any cause producing sluggishness of the circulation without true shock, such as a high spinal anesthesia or changes in position of the patient. The author has never found any harm to come to a patient when the blood pressure fell without a concomitant fall in the skin temperature. When however the blood pressure and skin temperature fall together the patient needs energetic resuscitation.

EDITH EASON M.D.

Intravenous Procaine: A Preliminary Report DAVID J GRAUBARD, RAFAEL W ROBERTZ and MILTON C PETERSON. *N York State J Med* 1947 47: 3187

This report deals with the intravenous use of procaine hydrochloride for the control of pain in traumatic and inflammatory conditions. There were no serious ill effects in 140 cases with 608 infusions.

The physiology and pathology of inflammation and the pharmacology of procaine are reviewed. The authors believe that in traumatized or inflamed areas procaine administered by the intravenous route has a twofold action: (1) direct action on the irritated nerve fibers, and (2) indirect action of the diethyl aminoethanol on the endothelium of the blood vessels.

To simplify the work, the term procaine unit was devised. This is the amount of procaine calculated at 4 mgm. per kgm. of body weight to be given

in 20 minutes in a 0.5 per cent isotonic saline solution. For accurately determining the dosage and for a constant uniform rate of administration a flowmeter was utilized.

Typical signs and symptoms as observed during the administration consist of a sensation of warmth throughout the body a flush over the head, face and neck, dryness of the mouth dilatation of the pupils and lightheadedness. Many patients feel comfortably relaxed with the alleviation of pain. The authors strive not to exceed these manifestations during the administration of procaine. They have noted no cases of procaine sensitivity or any contraindications to the use of this drug.

The results in the management of pain in trauma have been uniformly good, except for the cases of herniated intervertebral disk. The inflammatory cases on the whole responded well. In the miscellaneous cases, the results were relief of spasm increased mobility and improved muscular control.

It was concluded that

1. Intravenous procaine infusion for the management of pain in trauma and inflammatory conditions is a safe hospital procedure, provided that the administration is controlled.

2. The indiscriminate and careless intravenous administration of procaine may prove dangerous.

3. Intravenous administration of procaine should be considered as an adjunct to the management and treatment of selected traumatic, inflammatory and spastic conditions.

MARY FRANCES POT, M.D.

Pseudomonas Pyocyanea Meningitis following Spinal Anesthesia IAN M. DAVENPORT *Lancet*, Lond., 1947 1: 653.

The author points out that the conscientious recording of cases of meningitis following spinal anesthesia is important in order to emphasize the possible dangers of the method.

In one day the repair of 3 hernias was carried out under spinal anesthesia. The first patient made an uninterrupted recovery. In the 2 others *Pseudomonas pyocyanea* meningitis developed. One of these patients recovered after treatment with sulphamerazine, the second died.

An exhaustive attempt to trace the source of the infection in these cases was without success. In a similar case not reported here, the source was so-called sterile water in the operating theater.

Emphasis is laid on the importance of a rigid technique of asepsis in lumbar puncture whether for diagnostic or anesthetic purposes.

MARY FRANCES POT, M.D.

Discussion on Anesthesia for Cesarean Section RUFUS C. THOMAS, J. H. PEEK, C. MCINTOSH, MAX SMALL, KATHERINE LLOYD-WILLIAMS, and Others. *Proc. R. Soc. M. Lond.* 1947 40: 557.

THOMAS. The essential criteria for any anesthetic for a cesarean section must be safety for the mother and child and, subject to this, ease of operating for the surgeon. The discussant has used heavy nuper-

caline for many cesarean sections during the past 5 years. The arguments against spinal anesthesia for the pregnant woman are (1) it should not be used in patients with severe anemia and low blood pressure, (2) a number of cases of meningitis, some of them fatal, have followed spinal anesthesia, and (3) post-operative headache is not an infrequent occurrence.

Some advantages of spinal anesthesia with heavy nuper-caline include (1) it is relatively painless, (2) the anesthetic has no effect whatever on the baby, and (3) the surgeon has maximum relaxation for the operative procedure. The technique should be strictly and rigidly aseptic. The amount of heavy nuper-caline used is 2 c.c. given between the third and fourth lumbar vertebrae. This series includes 346 cesarean sections under heavy nuper-caline anesthesia. There were no deaths. The infant mortality rate was 3.4 per cent; 2 were stillborn, and 10 died.

PEEK. A brief résumé of 51 cesarean sections done under continuous caudal is given. There was no maternal mortality and no higher incidence of morbidity than is experienced in any series of cesarean sections. The advantages of continuous caudal anesthesia are enumerated.

MARSHALL. There are several reasons why inhalation anesthesia is unsatisfactory and dangerous for cesarean section. Accidents may occur during induction because of the light anesthesia with little if any preoperative medication which will cause vomiting and aspiration of the stomach contents into the bronchial tree. Furthermore, most of the inhalation anesthetics induce some degree of anoxia.

The only justifiable choice lies between spinal and local anesthesia when certain complications of labor have occurred. Spinal anesthesia is without effect on the fetus. Interest is increasing in local anesthesia for cesarean section, although it is not likely that many obstetricians will ever extend it to the majority of their patients. The discussant makes a plea that local anesthesia should be considered for the poor-risk patient. One word of warning is given to the effect that with an uncorrected transverse position the lower uterine segment should never be opened under local anesthesia alone. If the back or the shoulder and arm fall into the wound, extraction may be almost impossible.

LLOYD-WILLIAMS. The discussant gives an account of her wide experiences with anesthesia for cesarean section which dates from 1928 to the present time. Having tried most all forms of anesthesia she now prefers pentothal with gas and oxygen, adding trilete vinyl, or ethyl ether in minimal amounts. She does not recommend spinal anesthesia although it was used in 85 of her series of 304 cases.

DAWKINS. In this author's series of cases epidural anesthesia has given the most satisfactory results. The technique of this block is as follows:

A skin wheal is made between the second and third lumbar vertebrae and a Howard Jones spinal needle inserted in the midline. Odum's glass indicator containing an air bubble is attached and the needle is very slowly advanced into the ligamentum flavum.

until the air bubble is sucked in toward the patient by the negative pressure in the epidural space. Forty five cubic centimeters of 1-600 nupercaine in 0.45 per cent normal saline solution are used. Ten cubic centimeters are given slowly as a test dose, after it is certain that no cerebrospinal fluid can be withdrawn. After an interval of 5 minutes a further 35 c.c. of nupercaine are injected slowly (again with aspiration several times). The needle is then removed and the patient lies on her back in a slight foot-down tilt. It usually takes 25 minutes for the analgesia to be complete. In the discussant's experience all the babies breathed spontaneously at birth and there were no headaches, chest complications, or urinary problems. Vomiting was almost negligible.

CAVE. Under spinal anesthesia the surgeon can proceed with cesarean section at whatever pace he likes, safe in the knowledge that the fetus is not being affected. Furthermore the muscular relaxation will be good and there will be minimum risk of postpartum hemorrhage.

SMITH. This discussant has had wide experience with local anesthesia for cesarean section and finds it the anesthetic of choice. EDITH EASON, M.D.

Curare: Its Past and Present. STUART C. CULLEN
Anesthesiology 1947 8 479

This is a review of the history of curare and an investigation of the development of the preparations in clinical use today. Much is learned of the witch craft and daily lives of the South American Indians and the exploits of the early explorers. It is also evident that although we are able to apply the drug satisfactorily in clinical practice we have probably not extended the scope of its usefulness over that which has been proposed by the clinicians of the nineteenth century.

Clinical application was first attempted in 1866 by 2 French physicians who tried to allay and prevent the convulsions of epilepsy. Current enthusiasm for the clinical application of curare is largely due to the efforts of A. E. Bennett who popularized the use of curare in the control of convulsions associated with metrazol or electric shock therapy.

Bennett's exhibit at the 1940 meeting of the American Medical Association prompted several anesthesiologists to consider the possibility of using curare as a means of improving muscular relaxation during inhalation anesthesia. The rational and safe utilization of curare in anesthesiologic practice was

defined by the anesthesiologists who were among the first to employ curare in volume. These fundamental principles emphasized that curare was to be used only as a means of providing muscular relaxation and that some anesthetic or analgesic agent must be administered to provide pain relief. It was emphasized that the drug was selective in action and graded doses were recommended as being capable of producing the desired relaxation without interfering with the respiratory efficiency. It was emphasized that the principal advantage of curare in anesthesiology is to provide muscular relaxation and permit the anesthesiologist to effect anesthesia with low concentrations of potent anesthetic agents. It is also possible to extend the usefulness of impotent agents.

The laboratory investigations that accompanied the introduction of curare into anesthesiologic practice established the principle that the dose of curare is influenced by the anesthetic agent because some of the anesthetic agents have curariform properties of their own. Other research indicated that curare in therapeutic doses is capable of lowering the blood pressure in a few patients. It was determined further that curare does not alter cardiac rhythm nor does it interfere with certain elements of tissue metabolism, but it does cause relaxation of the small intestine. The lack of anesthetic or soporific properties of curare has been pointed out.

To date there has been a minimum number of disadvantages and dangers accompanying the rational use of curare. It is obvious that means for providing prompt and efficient artificial respiration must be at hand when curare is administered. The indiscriminate employment of prostigmine to overcome the effects of the improper use of curare should be discouraged. The bronchospasm may be relieved by the administration of additional curare. In spite of laboratory and considerable clinical evidence that curare has little or no influence on the heart and peripheral circulation it appears that large doses for long periods may cause a deterioration of the peripheral circulation.

Curare has secured a respectable position in the compendium of therapeutic agents. There is much that curare can do to enhance the knowledge of fundamental physiologic processes. It can be anticipated however that this jungle poison will justify the faith in it that all its ancient and contemporary patrons have had. MARY FRANCES POZ, M.D.

sputum are due to the asbestos needle, and serve as a nucleus surrounded by a gelatinous coating.

The symptoms are dyspnea and irritating cough. In advanced stages there are circulatory disturbances and hypertrophy of the right heart. Bronchopneumonia and bronchiectasis are secondary complications. Tuberculosis does not occur with asbestosis. The prognosis is not good, the average length of life being 15 years, whereas in silicosis it is 40 years. The time interval between exposure to the asbestos dust and development of the asbestosis is from 9 to 10 months.

The diagnosis of asbestosis is made by means of the clinical history and roentgenograms. It is divided into three stages. Stage 1 reveals a fine linear fibrosis in the basilar lung fields (Fig. 1). Stage 2 reveals nodules plus widened hila, but no hazy layering. Stage 3 reveals marked confluent density in the bases and emphysematous apices.

One hundred and twenty-six cases are reported. 94 (75%) were stage 1 with an average mean exposure of 3.4 years. 23 cases (18%) were in stage 2 with an average mean exposure of 7.9 years and 9 cases (7%) were in stage 3 with an average mean exposure of 11.5 years. MAURICE D. SACHS, M.D.

The Roentgenographic Diagnosis of Perforations of the Upper Gastrointestinal Tract into the Mediastinum and Pleural Cavity. GORDON J. CULVER and STANLEY B. CLARK. *Surgery* 1947 23: 458.

Esophageal perforation still carries an extremely high mortality rate. The prognosis depends in part on the location, perforations high in the esophagus having a better prognosis than those lower down. Moerl gave the following reasons for this: (1) a perforation in the cervical portion of the esophagus leads to inflammation in the mediastinum which has a tendency to spread upward where it is more accessible to surgery; (2) any inflammatory process in the upper mediastinum remains more circumscribed than one located lower down; and (3) the site of perforation can easily be reached also with the aid of the esophagoscope. The duration of the underlying pathology prior to the perforation has an additional influence. A long standing process is more apt to lead to a localized periesophagitis than a diffuse mediastinitis because of the time it had to produce a walling off of the inflammation. Perforations of the lower esophagus commonly rupture into the pleural cavity with an invariably fatal outcome.

The perforations occurring higher in the esophagus may be due to foreign bodies, instrumentation or some pre-existing lesion as for example, diverticulum, ulcer or carcinoma. In the lower esophagus because of the weak wall, perforation may result spontaneously under increased pressure from vomiting, retching or coughing.

The authors had the opportunity of observing 4 cases of perforation of the esophagus. Instrumentation was the cause in 2. In the third case there was a pre-existing peptic ulcer of the lower esophagus, and



Fig. 1 (Wegelin) Asbestosis, stage 1. Fine network in the middle and basal fields of the lung picture, already layered with small soft spots. (See p. 304 for abstract.)

in the fourth an ulcer of the cardioesophageal junction. The cases are briefly described and illustrated with their respective roentgenograms. Three of the patients died shortly after the initial symptoms. The fourth patient experienced a perforation high in the esophagus with emphysema of the neck and mediastinitis, and recovered. In the 2 cases with pre-existing ulcers the perforations followed attacks of sudden vomiting, both patients having consumed alcohol prior to the onset of symptoms. Ellason and Welty likewise, described 2 esophageal perforations which resulted from bouts of vomiting and retching after an alcoholic spree.

In 3 of the 4 cases reported by the authors the outstanding clinical manifestation was the resultant hydropneumothorax. In the fourth the perforation was high in the esophagus and there was only mediastinitis present, from which the patient recovered.

The authors believe that a roentgenographic finding of hydropneumothorax associated with the clinical findings of sudden thoracic and/or abdominal pain, shock, and collapse should make one suspicious of perforation of the lower esophagus or stomach into the mediastinum and pleural cavity. A spontaneous pneumothorax is differentiated on the basis of the fact that no pleural effusion is present or if fluid forms, it does not appear until later. A review of the literature shows that most investigators considered the roentgen demonstration of hydropneumothorax, especially in the presence of some pre-existing lesion or a history of swallowing a foreign body or caustic fluid as being diagnostic of esophageal perforation.

Several investigators gave contrast media by mouth in order to visualize the communication between the esophagus and pleural cavity. However, unless the perforation is located in the upper or cervical portion of the esophagus such a procedure is dangerous.

T. LUCOTTA, M.D.

Röntgen Diagnosis in Epiphyseolysis (Coxa Anteverta) MAURICE M. POMERANTZ, *Bull. Hosp. Joint Dis.* N Y 1947 8, 5

The roentgenographic features of epiphyseolysis are reviewed. This condition is of more frequent occurrence and importance than is commonly recognized, and the author had observed approximately 500 cases up to the time of his report. For purposes of roentgenographic description and study he classifies the lesions as follows: (1) slight slipping (2) moderate slipping (3) extreme slipping (4) acute, and (5) chronic (6) long-standing examples.

The earliest distinctive sign of slight slipping when present, is the loss of the "hump" formed by the projecting lip of the epiphysis. After 8 or 9 years of age this normally extends slightly beyond the limits of the superior border of the femoral neck. Occasionally the only sign of the early stage of this condition is merely widening of the epiphyseal plate. On lateral projection there is beginning anteverision of the femoral neck. On anterior posterior roentgenogram, there is a slight increase in the density of the base of the epiphysis which indicates that its position has already been altered by rotation. Under normal conditions in many hips, the epiphyseal plate appears serrated. As the femoral head is detached the serrations disappear and the plate surface of the epiphysis appears as a curved fairly dense line parallel to the margins of the femoral neck. Roentgenographically the epiphyseal line is of increased width there may be noted patchy, confluent, or roughly circular zones near the epiphyseal plate due to irregularities in contour of the epiphyseal surface of the anteverticed neck.

In moderate slipping the condition has advanced so that the capital epiphysis has slipped from one eighth to one-half inch. As the epiphysis is detached it rotates downward so that its widest diameter is nearly in a horizontal plane. It is slightly reduced in height. The head of the femur does not leave the acetabulum—it merely shifts its position within the socket. The epiphysis rotates backward and the anterior lip of the epiphysis migrates inward. As a result of anteverision, the femoral neck appears foreshortened and its upper extremity projects well beyond the limits of the superior pole of the epiphysis.

In extreme slipping there is complete detachment and rotation of the femoral head which, at times, amounts to 90 degrees and the associated extreme anteverision of the neck.

In the acute form of the condition there is usually a history of severe trauma with the associated clinical symptoms of a fracture in the chronic variety there may or may not be a clear history of trauma or one of repeated slight injuries which may not be sufficiently severe to incapacitate the patient. In general, then, any injury may completely separate the femoral head and neck and initiate acute symptoms.

In long-standing examples the condition represents the end results of all stages of the disease in which

the epiphysis is united with the neck and the resultant deformity. FRANK L. HENRY, M.D.

The Value of X Rays in the Study of Postoperative Emergencies and Complications. JAMES T. CUMMINGS, *J. Surg.* 1947 74, 414.

The author presents a series of cases which demonstrate the value of x-ray study in abdominal emergencies and postoperative complications. In the first group of cases are those of intra-abdominal abscess formation.

Case 1 deals with a patient who had recently undergone an operation for drainage of an appendiceal abscess. The clinical findings suggested further abscess formation. A scout film of the abdomen was inconclusive, although absence of gas shadows in the lower left quadrant suggested this as the site of the abscess. A film taken 5 hours following the ingestion of umbratron showed the bowel loops displaced from the lower left quadrant in a manner to definitely indicate an abscess in the lower left quadrant of the abdomen.

Case 2 is a similar one in which the condition followed an appendectomy. Visualization of the colon with an opaque contrast revealed the cecum and ascending colon to be displaced markedly leaving a large vacant space on the outer side of the cecocolon which indicated that an abscess was located in this region.

In case 3 a scout film demonstrated the location of an abscess by the presence of an area which was free of gas shadows and later displacement of a barium filled colon verified it.

In the second group of cases roentgenograms are utilized to demonstrate free air under the diaphragm as its cardinal sign. One group of such cases is represented by rupture of a hollow viscus, such as a duodenal ulcer, an ulcer of the colon, etc.

In case 4 films taken in an upright position reveal a small parallel translucent zone beneath the cupola of each diaphragm which indicates the presence of air due to a ruptured viscus.

A case of subphrenic abscess is that of a woman (case 5) who recently had an operation for a suppurating gall bladder. Roentgenograms revealed elevation of the right diaphragm and some irregularity of the diaphragm in the region of the costophrenic angle. There was no fluid level. In the majority of cases of subphrenic abscess there is no evidence of a fluid level. On fluoroscopic examination fixation of the diaphragm and supraphrenic loop shadows are significant.

Occasionally gas supernatant above the fluid in an abscess is visualized. In case 6 a large gas containing shadow below the right diaphragm indicates the presence of a subphrenic abscess.

In case 7 a lateral position film demonstrates the large right subphrenic abscess. Left subphrenic abscess is considerably less frequent than right.

In case 8 elevation of the left diaphragm, a small pleural effusion, a fluid level with gas above it

below the cupola of the left diaphragm and visualization of the mesial outline of the abscess by contrast material in the stomach demonstrated a left subdiaphragmatic abscess.

In case 9 a film taken with a drainage tube in a subphrenic abscess illustrated perfect drainage in the absence of a fluid level.

In case 10 a bedside roentgenogram revealed a large subphrenic abscess on the right side which was evacuated. After a few days a colon study revealed the tip of an inverted cecum well up under the edge of the liver and opaque material flowing from the cecum into the drainage tract thus demonstrating the cause of the abscess as being that of a ruptured subhepatic appendix.

In case 11 the first x ray film showed flattening and elevation of the cupola of the right diaphragm. On a supine roentgenogram enlargement of the liver was seen. The findings suggested a liver abscess which was not complicated by an aerogenic organism. 300 c.c. of pus were removed by aspiration. In liver abscess of this type fluoroscopic examination from day to day reveals a decrease in the excursion of the diaphragm followed by a final cessation of excursion of the diaphragm on the liver side. Intravenous injection of thorotrast may be used to help visualize a hepatic abscess. X rays are of great aid in biliary tract complications. At the time of surgery the surgeon can introduce some form of opaque material preferably thorotrast into the gall bladder or common duct to determine the patency of the duct or the presence of stones. Before removal of drainage tubes from the common duct its patency is determined by the above method.

In case 12 a nonvisualization of the gall bladder following a recent closure of a gall bladder drainage indicated an obstruction in the cystic duct, which at surgery was found to be an inch long piece of heavy silk. Another group of postoperative cases in which x rays are of value are those in which there are complications following gastroenterostomy, such as simple invagination of one loop or of double loop invagination of a small bowel into the stomach through the gastroenterostomy stoma.

In cases 13 and 15 jejuno gastric invagination was demonstrated on filling the partially resected stomach with barium.

In case 14 a stenosis at the site of the stoma was demonstrated by visualization of dilatation of the duodenum and upper jejunum on x ray examination.

Another group of cases of x ray interest are those of intestinal obstruction. In cases 16 and 17 which were similar the colon was seen to be markedly distended. This was relieved by enema.

Case 18 was one of acute obstruction of the small intestine following operation. In this case characteristic stepladder or parallel arrangement of the coils of small bowel was seen. The coils of small bowel are easily recognized due to the herring bone appearance produced by the valvulae conni-

ventes. Fluid levels in the bowel may be demonstrated by upright or lateral reclining films. A small amount of barium or mbrathor may be used to visualize the small bowel more distinctly but is not considered necessary.

Films of cases 19 and 20 demonstrate the use of umbrathor or barium. Intubation of the small bowel which has become quite popular should be controlled by x ray study. The use of the tube is attended however by a certain danger because of delay.

FRANK L. HUMBY, M.D.

MISCELLANEOUS

Preparation of Radioautographs of Thyroid Tumors for Study of High Magnification Truss C Evans. *Radiology* 1947 49 206

In the usual procedure of preparing radioautographs the tissue section mounted on a microscopic slide is placed against a photographic emulsion for a suitable time in the dark. After the proper exposure the two are separated. The photographic image is developed, the microscopic section is stained and a comparative study is made.

A closer contact between the tissue and the photographic emulsion, however, seems desirable. It occurred to the author that the mounting of the tissue section directly on the photographic plate might be advantageous. With this view in mind he elaborated a technique which is similar to that used in preparing histologic slides when paraffin sections are floated onto the microscopic slide. The technique is described in detail.

The present article is limited to radioautographs of thyroid tumors containing radioiodine but the method is applicable to other radioactive substances and other tissues as well. The Eastman median contrast lantern slide plates were found to be the most satisfactory for the autographs. The 2 by 2 inch size is used when the tissue layer is floated on the plate and the 3½ by 4½ inch size when the microscope slide containing the tissue is taped to the plate as in the older method. It is best to produce both types of autographs to obtain a comparative study.

The author cites several cases in which the method has been used to advantage and presents several photomicrographs and autographs prepared by both techniques to prove the point. In the newly described technique proper alignment is automatic and a higher magnification with good detail is possible because the tissue is not removed from the photographic plate. As one changes from low power to high power the plane of the tissue section and of the autograph becomes distinctly separate.

Thus by mounting the tissue directly on the photographic plate one obtains a differential 'staining' of either large or minute regions that have taken up the radioactive iodine. This helps in the study of thyroid function and may aid in determining whether or not a certain case of thyroid neoplasia should be treated with radioactive iodine.

T. LEUCUTIA, M.D.

The Metabolism of the Fission Products and the Heaviest Elements. JOE G. HAMILTON. *Radiol.* 97: 947-49, 1955

Fission products getting into the body are dangerous because the quantities which are dangerous are minute compared with those necessary to produce damage by external beta or gamma irradiation. The fission of uranium results in the production of 34 radioactive elements from zinc to europium as well as nearly 200 known isotopes of these 34 elements.

This is a study of the absorption, distribution, retention, and excretion of these radioactive elements. In addition, the behavior of these radioactive elements was observed following their introduction into the body by the 3 major portals of entry: namely, inhalation, oral ingestion, and through cuts and abrasions of the skin. This study is important because very little is known about the metabolism of the radioactive elements involved. The fission products included in this report were strontium, yttrium, zirconium, columbium, ruthenium, tellurium, iodine, xenon, cesium, barium, lanthanum, cerium, praseodymium, and element 61. The studies are being extended to include others of the fission products and eventually it is planned to include them all. Plutonium and the actinide elements (heaviest elements) were also studied.

The method used was to do tracer studies on rats following oral ingestion, inhalation and parenteral

injection of these elements. The absorption, distribution, retention, and excretion of each substance were determined and radioautographic studies were made if there was a high degree of selective absorption to correlate an accumulation of the radioactive elements with the microscopical anatomy.

Only 5 of the fission products included in the study were absorbed to a significant degree from the digestive tract. These were strontium, barium, tellurium, cesium and iodine the latter being absorbed completely. The absorption from the lungs was discussed but the most significant feature appeared to be the metabolic patterns observed following parenteral administration.

There was a surprising predilection to prompt deposition and prolonged retention in the skeleton of many of the long life fission products and the actinide elements. The radioautographs of these elements showed that all of these elements that accumulated in the bone, except strontium, are not deposited in the mineral structure of the bone but rather appear to be localized in and adjacent to the osteoid matrix; thus the radiation was brought in close contact with the radiosensitive bone marrow. It was noted that lanthanum, cerium, praseodymium, element 61, americium and curium have a rather large fraction deposited in the liver. All of the elements except columbium accumulated in bone and were released at a very slow rate.

STUART A. PATTERSON, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Homologous Serum Jaundice. I. JAY BRIGHTMAN and ROBERT F. KOFFER. *J. Am. M. Ass.* 1947 135 168.

The ready availability of pooled plasma whether secured through commercial channels, state departments of health or local blood banks has been a boon to medical practice. However, the fact that plasma may carry a virus capable of inducing hepatitis in the recipient has created a new public health problem of major importance.

Follow-up of 649 patients who received transfusions with dried pooled plasma revealed a subsequent incidence of homologous serum jaundice in 4.5 per cent of the patients.

The causative agent appeared to be widely distributed but the rate of attack was variable.

It was significantly higher among persons who were 50 years of age or more. No relation of the attack rate to the amount of plasma administered could be demonstrated.

Investigation of 51 deaths attributed to acute hepatitis revealed 15 cases in which the patients had received transfusion therapy during the 6 months prior to death. Twelve of these had received plasma only.

Twelve deaths attributable to homologous serum jaundice were reported in Upstate New York during a 7 month period.

Plasma, as well as other forms of transfusion therapy should be administered only when the clinical indications are absolute so that the benefits to be derived clearly outweigh the risk of contracting homologous serum jaundice.

Immediate, intensive research toward the elimination of the causative agent is imperative.

HARRY W. FINE, M.D.

Ascariasis as a Surgical Disease (Ein Beitrag zur Askariasis als chirurgische Erkrankung)
NORBERT ZYLKA. *Deut. med. Wochschr.*, 1947 73 417

Shortage of anthelmintic drugs and the extensive use of manure in place of artificial fertilizers are responsible for the great frequency of ascariasis among German children. The author was able to establish the diagnosis of infestation with ascaris in 1 of each 3 children in his institution.

In the course of a year ileus caused by ascaris worms required an operation in 5 patients, 3 children and 2 adults. An ascent of the worms into the biliary ducts was not observed. In several instances the worms evidently reached the stomach because they were found in the vomitus. The third grave complication, namely a penetration of the intestinal wall with subsequent peritonitis was not observed by the author.

In a 34 year old man not less than 1,000 worms produced within the intestines a mass 1 meter long.

All of the patients recovered from the operation which consisted of an enterotomy and removal of the worms.

JOSEPH E. NARAT, M.D.

Two Cases of Primary Suppurative Psoas Myositis.
EMO E. VUORI. *Ann. Chir. Scand.* 1947 96 87

Primary suppurative myositis is a purulent inflammation occurring both in the parenchyma and in the interstitial connective tissue of a muscle and is limited by the muscular fascia. It occurs in patients who present no associated concurrent disease in other parts of the body. Myositis occurs most commonly in one muscle. In the psoas region a primary suppurative myositis is rare but secondary myositis is frequent.

The first case was that of a woman 22 years old. Two months before admission the patient fell on her seat on slippery ice. After some days pain "inside the pelvis" started; it increased daily and caused a limp in the right leg. Walking was easiest in the bent position. Fever began at the same time. The symptoms disappeared almost completely with bed rest and heat although there still was a limp. On admission she had fever, spastic flexion contracture of the right thigh to about 60 degrees, severe pain on attempted extension of the thigh and a palpable tender mass in the iliac fossa. The right psoas shadow did not show on roentgenographic examination. A diagnosis of an abscess of the psoas muscle was made and it was drained operatively. The organism was a staphylococcus. Two days later the temperature was normal and the contracture relaxed. A follow up 9 months later showed no residual difficulty.

The second case was that of a man 32 years old. Three weeks previous to examination a pain had begun spontaneously on the right side, deep in the lumbar region. It gradually increased. Also gradually increasing limp was apparent until the patient was unable to walk on admission. He had a fever, slight flexion contracture of the right thigh, pain on attempted extension, pain on pressure at the base of the right thigh on the medial aspect and a mass on the right side. The abscess was drained through the back. In 1 day the temperature was normal. A follow up 5 months later revealed no marked residual difficulty. The organism was a staphylococcus.

Similarly as in these 2 cases, the causative organism reported in the literature has been the staphylococcus most commonly the staphylococcus aureus. The streptococcus, pneumococcus or Pfeiffer's bacillus influenzae has rarely been the cause of the disease. The point of entry has sometimes been a small infected excoriation or an acne pustule, tonsils have been suspected and the appendix has been indicted. Most of the conditions have been on the right side. Small hematomas arising in connection with muscle trauma are probably predisposing factors also very strenuous work. The infection may spread into the

muscle by the hematogenous as well as the lymphatic route.

The most important symptoms are fever often high and septic, consequent impairment of the general condition and a swollen and tender muscle tumor without peritoneal irritation but accompanied by a spastic flexion contracture of the thigh with slight outward rotation. The only movement which causes pain is extension of the thigh and this may be considered pathognomonic of the disease.

Complications that may occur are collateral periurethritis or displacement of the kidney with secondary temporary hydronephrosis, perforation into the peritoneum, intestine or bladder extension below the inguinal ligament, meningitis from penetration of the dura, and metastatic infections.

In the differential diagnosis the following diseases should be considered: purulent coxitis, abscesses descending from tuberculous or nontuberculous spondylitis, osteomyelitis of the ileum, purulent ilioacral arthritis, and periappendicular and pararenal abscesses. All the bone and joint lesions should be differentiated by x-ray study as well as clinical manifestations. Periappendicular abscesses do not cause contracture of the psoas muscle as a rule whereas pararenal abscesses may cause even a severe psoas contracture. The latter differential diagnosis may be impossible but the treatment is the same as far as the abscesses are concerned.

Treatment is extraperitoneal incision and drainage of the abscess. The incision is made from the back above the crest of the ilium if the position of the abscess is high but from the front in cases of low abscesses. As the causative organisms are generally staphylococci and less often streptococci, and only in rare instances other bacteria, recovery may probably be brought about by the use of sulfonamides or penicillin alone if administration is early. The prognosis is excellent if the patient receives proper treatment. **LE ROY J. KLEINSMAN, M.D.**

Tropical Ulcer J. A. LICHTMAN CH. Proc., Cape Town, 1947 6 65

In 1945 the writer encountered a prevalent form of leg ulcer in the Natal Bantu which, since 1944, has been referred to here as "tropical ulcer." This ulcer has been described under numerous other names by various authors in the past.

The author observed 100 of these ulcers personally. The majority were chronic with a duration of from 1 to 2 months. The ulcer probably begins as an infection of a wound or sore or as a spontaneous vesicle which bursts in a few days. It usually occurs on the lower extremity below the knee. The most common sites are the anterior surface of the tibia, over the malleoli or over the dorsum of the foot. Pain was usually present but not severe. A fetid odor was characteristic. The edges of the ulcer were raised and indurated. The base was firm and adherent. A tenacious yellowish gray slough covered the floor. Beneath this, granulation tissue was exuberant. An abundant sanguineous discharge was often present.

The shape of the ulcer was often irregular or the ulcer was undermined which suggested a local acute exacerbation of a chronic process. Extension in depth was common. Multiple ulcers were often present close together—an example of autoinoculation. Lymphatic spread, toxemia, septicemia, and fever were conspicuously absent. Malignant transformation was not encountered. The surrounding skin often showed pigmentation, "crusty paving" (signs of vitamin B deficiency) and scars of previous ulcers (one ulcer did not confer immunity).

The immediate cause of an ulcer is a localized defective blood supply usually due to inflammation and infection. Various bacteria were found in these ulcers but the most common and constant were fusiform bacilli and spirochetes. Diphtheria or diphtheria-like organisms were never found, in contrast with yaws. Leishman-Donovan bodies and mycotic organisms were not found. The fusiform bacilli and spirochetes were morphologically identical with those of Vincent's angina bacillus. The frequent presence of these organisms is evidence that they were pathogenically causal and not merely saprophytic. When they were absent the patient was under active treatment or the ulcer was atypical. Other authors have often noted the presence of these organisms with the type of ulcer described. Saprophytic organisms do not invade living tissue, but in tropical ulcers various authors have noted the invasion of living tissue by spirochetes or fusiform bacilli. Tropical ulcers have been produced in volunteers by using pure cultures of fusiform bacilli. A transiently positive Wassermann reaction may occur in tropical ulcer. This has been demonstrated in cases of tropical ulcer from which pure cultures of fusiform bacilli were obtained.

Frank trauma, insect bites, and infestations are important in initiating an ulcer. Fusospirochetal organisms are common in normal and diseased mouths. The mouth has often been assumed to be the reservoir of the organisms of tropical ulcer—the mode of infection being promiscuous expectoration or intentional application of saliva as a hemostatic to an injury. The clinical and bacteriological features of human bites are seen to resemble tropical ulcer closely. Insects may mechanically transmit the organisms. The soil and water have been believed to harbor them; this may explain the usual occurrence on the legs.

Customs of dress and increased skin moisture may explain why the ulcers are confined to hot climates. There is a definite autumnal increase of these ulcers. This has been linked to dietary deficiency of protein and vitamins which is corrected during the winter.

Syphilis has been suggested as a cause for tropical ulcer. However the finding of a positive Wassermann reaction assumes less importance when it is considered that a large proportion of the native population suffers from syphilis or yaws. Besides, many cases of tropical ulcer give a negative reaction. All of the author's cases had negative blood smears for malaria. The stools in this series were negative for

hookworm ova and the unnes for bilharzic ova. It is possible that sickle cell anemia predisposes to tropical ulcers.

A dietary deficiency of calcium has been linked to an increased incidence of tropical ulcer. In the author's series avitaminosis was common among the controls but it was more marked in the ulcer cases. He believes a deficiency of nicotinic acid and riboflavin is an important predisposing cause. These vitamins are of great importance in the transfer of oxygen to living cells. Fusiform bacilli are anaerobic. Hence it is postulated that *in the competition for blood oxygen the fusiform bacilli are at a considerable advantage when these vitamins viz. nicotinic acid and riboflavin are deficient*.

With regard to age, school children predominated in the author's series. This may have been due to the teachers sending them to the hospital. Males were found more frequently in the ratio of 14 to 9. This may reflect the traumatic factor. Interestingly in the autumnal ulcer season, when dietetic factors are important, the sex incidence is almost equal.

In summary fusospirochetal organisms are believed to be the exciting cause of tropical ulcer. Access to tissues is gained through trauma to which the legs are prone. Deficiency of nicotinic acid and riboflavin is believed to be an important predisposing cause in that these deficiencies predispose to an anaerobic condition in the tissues.

JAMES WEAVER M D

Paths of Cancer Biotherapy N G KLYUKVA. *Am Rev Soviet M.*, 1947 4 408.

Biotherapy of malignant neoplasms falls into 3 categories

1 The action of folic acid. Prolonged use of folic acid has caused a regression of mammary cancer in 40 per cent of treated mice. No information is available regarding its effectiveness in the treatment of cancer in human beings.

2 The action of products of bacterial origin. The polysaccharide fraction from the *Bacillus prodigiosus* proved to be highly toxic to animals and man. Its injection was followed by fever, fall of the blood pressure, anuria, cardiac decompensation and collapse. It appears that products of bacterial origin at present, fail to give positive results.

3 The action of the South American trypanosome, *Schizotrypanum cruzi*. In a normal animal trypanosomes multiply in the heart, spleen, liver, bone marrow and lymph glands. In an animal with malignant growth, the trypanosomes are absent from these organs, and are concentrated in the neoplasm. They multiply there in large numbers and are often found within the cell.

The experiments made on white mice with transplanted sarcoma 180 showed that the strain had a potent inhibitory action. The degree of inhibition was directly proportional to the duration of the trypanosome infection. From 7 to 8 days after the injection of trypanosomes, a cessation of tumor growth could be noticed. On the eleventh day 50

per cent of the animals had no tumors, and 14 days later 85 per cent of the animals showed tumor regression while 92 per cent of the control groups showed actively growing sarcomas. The author reports the use of the cancerolytic substance KR. Favorable results were obtained in 10 patients with cancer of the larynx, in 3 with cancer of the cervix, and in 3 with cancer of the breast.

TABLE OF COMPARISON

Anticancer substance KR	Polysaccharide fraction
1 Is contained in the body of the trypanosome <i>schizotrypanum</i> .	1 Is contained in the filtrates of the culture of the <i>Bacillus prodigiosus</i> .
2 Acts on cells of an experimental implanted sarcoma, cancer, and spontaneous adenocarcinoma.	2 The same.
3. Destroys cells of malignant human neoplasms.	3 Inconclusive.
4. Effect directly proportional to the dosage of the injected substance and the number of injections.	4 Effect directly proportional to the dose of the injected substance and inversely proportional to the number of injections.
5 Disintegration of the nucleus and protoplasm of the cancer cell into separate fragments, lysis of the cell, and replacement by connective tissue.	5. Formation of a hemorrhage in the cancer and a necrosis of the cancer cells.
6 Parenteral introduction of cancerolytic doses into man is not toxic.	6 Therapeutic doses are highly toxic.
7 Extracted from the body of the trypanosomes together with a protein and carbohydrate fraction.	7 Represents a molecule of a polysaccharide.

TABLE OF CONCENTRATION OF KR AND DOSAGE

1 Number of cells in 1 c.c. of the host's plasma—5,000,000
2 Number of cancerolytic units (C U) in 1 c.c. of the host's plasma—5
3 Dosage of one injection (in units)—from 30 to 35
4 Maximal number of injections in a course of biotherapy (in units)—from 45 to 50
5 Maximal number of cells used in one course of treatment—755,000,000
6 Maximal doses of KR given in one course (in units)—755

The experiments showed two phases (1) regression and absorption of the malignant tissue following the action of the cancerolytic substance, *schizotrypa*

num (known as KR) and (s) regeneration, shown by an increase in fibroblasts and of fibrosis. The correlation of cancerolysis and of fibrosis determines the outline of the biotherapy

LEE PULLER, M D

EXPERIMENTAL SURGERY

Homotransplantation of Fetal Skin. DONALD E. BARKER, *Arch. Path. Chic.* 1947 44: 166.

Because of the previously reported conflicting results in the homotransplantation of fetal skin an attempt was made to compare the results of homotransplantation of fetal and adult skin. Black and white guinea pigs weighing from 8 to 13 ounces were used as recipients. A 1 millimeter square of black skin from each fetus and each adult was transplanted to a white rump area. The fetal skin was obtained from fetuses 1 to 7 cm. in length immediately after cesarean section. For the transplantation of adult skin guinea pigs from 4 to 5 months of age were used.

It is apparent, from the results obtained in this series of experiments, that the younger fetal skin is not as well prepared to withstand transplantation as the older fetal skin. The percentage of primary takes when the older fetal tissues were used was comparable with that attained when adult tissue was used. The main difference between older fetal tissues and adult tissue is that the fetal skin exhibits early proliferation and multiplication of the cells with enlargement of the graft, while the adult grafts usually do not increase in size. In the guinea pig the use of fetal skin for permanent transplantation is no more successful than that of adult tissue. The early proliferation of such transplanted fetal skin is of short duration and is followed either by a rapid melting away of the graft or by its slow regression.

FRANK F. KANTHAK, M D

Pigment Changes in Experimental White Thymic Skin Grafts. DONALD E. BARKER, *Arch. Path., Chic.*, 1947 44: 163.

Previous experimental work by Loeb and others has produced divergent opinions on the invasion of pigment into surrounding tissue after skin grafting. With this in mind the author has restudied the problem with the use of black and white guinea pigs. The hair was clipped and the skin shaved. With a sterile cork borer 17 mm. in diameter two circular areas were marked out, one in black and the other in white skin. The skin so outlined was excised and each piece was transferred as a free graft, the black graft to the white area and vice versa. The grafts were sutured in position and dressed with petrolatum gauze and a sea sponge pressure dressing. The dressings were changed at the end of 12 days and the grafts were observed periodically from then on.

In 11 of 50 guinea pigs, takes of both the black and the white grafts were obtained and the observations reported were made on this group of 11 animals. During the first 4 weeks following transplantation the grafts shrank to about one-half their original size. When the shrinkage had ceased the pigment of the black graft gradually invaded the surrounding white area. This extension of the black pigment continued for as long as 93 days. In contrast to this, in all 11 animals the white graft was gradually invaded by the surrounding black pigment until the graft was no longer visible. In 9 of the 11 guinea pigs this invasion of the white graft was completed within 60 to 80 days. The hair growth of the grafts was sparse, but the hair grew out of the grafts in the original direction of the growth. It was noted that in the case of the white grafts, white hair continued to emerge from the grafted area for as long as 5 months even though complete pigmentation of the original white graft had taken place.

FRANK F. KANTHAK, M D

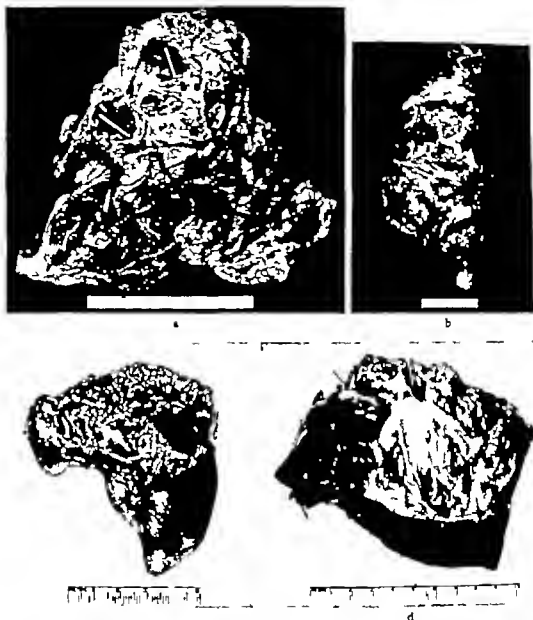


Fig. 5 a, Right lung removed at operation in case illustrated in Figure 4, a and b. Note the external destruction of lung tissue. b Operative specimen of left upper lobe. Roentgenograms of this case are shown in Figure 6 a and b. c, Operative specimen of segmental resection of the superior

division of the right lower lobe. This specimen is from the same case as shown in Figure 6, c and d. d, Right lower lobe which was removed for chronic lung abscess. The specimen reveals the presence of a small bone as the cause of abscess formation. See number 8 under Indications for Pulmonary Resection.

Pulmonary Resection for Abscess of the Lung —

Robert P. Glover and O. Theron Clagett

SURGERY

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PULMONARY RESECTION FOR ABSCESS OF THE LUNG

ROBERT P. GLOVER, M.D. and O. THERON CLAGETT, M.D., F.A.C.S.
Rochester, Minnesota

THE past ten years have witnessed a marked and gratifying improvement in the treatment of pulmonary disease. Especially has this been true with regard to the various forms of suppuration. Prior to this time the prognosis of lung abscess was dismal indeed. Conservative measures alone were rewarded by a mortality rate ranging from 35 to 70 per cent and less than half of those who survived were cured (9, 10, 23, 24). The addition of bronchoscopic and surgical drainage to the existing medical regimen lowered the mortality rate considerably but asymptomatic cures still obtained in less than 50 per cent (2, 4, 5, 6, 8, 15, 16, 22, 23, 25). It became apparent that as long as a conservative and supportive program of some 6 to 12 weeks existed before the institution of surgical treatment no better results could be anticipated. The impetus for this change in thought was supplied by Neuhoef and his associates (17, 20) and a large measure of credit is due them for the increasing reduction in mortality and morbidity of late. They showed that when the problem of lung abscess is treated as surgical from the onset with the employment of immediate or early drainage deaths can be reduced to less than 5 per cent with cures ranging correspondingly high. These results have been confirmed by many others including Betts and Overholt and Rumel.

Unfortunately these facts have not been fully appreciated by those physicians who are

in a position to deal with such cases at their inception. The advent of chemotherapy and the antibiotics has further tended to postpone a more definitive surgical attack so that there is a tendency to revert to the so called more conservative attitude in the hope that newer drugs can accomplish cures denied to earlier medical regimens. In an effort to forestall any such fallacious thought this study was undertaken. Our attempt is twofold in character. It will evaluate the results of prolonged conservative treatment with or without chemotherapy before surgical intervention and at the same time indicate what can be accomplished by pulmonary resection in lieu of over-optimistic medical care.

During the 10 year period from January, 1937 through December, 1946 pulmonary resection has been performed in 37 cases of lung abscess at the Mayo Clinic. These cases were taken from a large number in which resection was performed for pulmonary suppuration. They represent only those in which the diagnosis from the onset was that of lung abscess exclusive of underlying pathologic changes such as pre-existing tuberculosis, malignant lesions or bronchiectasis. The difficulties attendant on excluding pre-existing bronchiectasis can be readily appreciated. In short however all cases considered in this paper are those in which the patients were well before the present illness without history of previous pulmonary disease and in which disease began with acute symptoms during

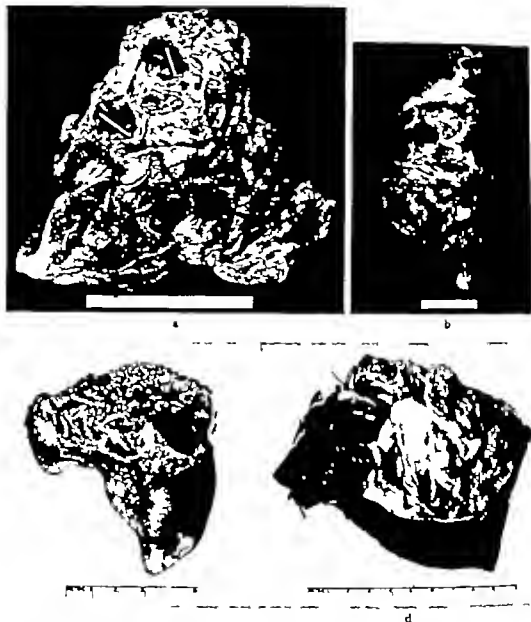


FIG. 5. a, Right lung removed at operation in case illustrated in Figure 4, and b, Not the extensive destruction of lung tissue. b Operative specimen of left upper lobe. Roentgenograms of this case are shown in Figure 6, and b c, Operative specimen of segmental resection of the superior division of the right lower lobe. This specimen is from the same case as shown in Figure 6, c and d. d, Right lower lobe which was removed for chronic lung abscess. The specimen reveals the presence of small bone as the cause of abscess formation. See number 8 under "Indications for Pulmonary Resection."

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which the diagnosis of lung abscess was made primarily and progressed to various stages of chronicity under medical management including repeated bronchoscopic aspirations and dilatations chemotherapy and administration of penicillin.

In 20 cases abscess occurred during the course of a respiratory infection usually stated as being pneumonia. The presenting symptoms in all 20 cases were chills fever cough sputum frequently blood tinged and pleurisy. In 11 cases the abscess followed the administration of an inhalation anesthetic agent, most frequently in operations about the mouth such as tonsillectomy extraction of teeth and drainage of sinuses. In 5 cases a foreign body was found in the resected specimen in 3 of these the history of aspiration had been obtained but in 2 this finding was totally unsuspected. In the 1 final case the abscess followed an injury to the thoracic wall in which a segment of rib had pierced the lung causing hemoptysis infection and cavitation but no hemothorax.

All but four of the patients in the entire series had been given at least one course of chemotherapy or penicillin (some as many as six) and in all cases both therapeutic and diagnostic bronchoscopy had been performed repeatedly. In addition 7 of the patients had undergone previous surgical procedures: 2 had artificial pneumothorax 2 had rib resection and open drainage twice 1 had open drainage once 1 had open drainage followed by a six rib thoracoplasty and 1 had an empyema drained—all the foregoing without lasting benefit. The average elapsed time from diagnosis to resection for the 37 cases was 18 months, the extreme being 11 years indicating that this presentation obviously concerns the chronic form of lung abscess, a condition which calls for resection of destroyed tissues and not drainage such as would be considered in dealing with an early uncomplicated abscess. The relationship of surgical drainage and resection will be discussed later.

ANALYSIS OF MATERIAL

Thirty seven patients who had lung abscess in various stages of chronicity underwent pulmonary resection. There were 2

cases of partial resection 16 of lobectomy 3 of bilobectomy and 16 of pneumonectomy.

Partial resection. It is relatively rare to find the surrounding pathologic changes of pneumonia fibrosis, and bronchiectases which accompany chronic abscess so localized as to permit resection short of lobectomy. We do not advocate such an approach feeling that complications are far more likely to arise when infected tissue acute chronic or macroscopic, is traversed. These 2 cases presented unusual findings. In the first a segmental resection of the superior division of the right lower lobe was possible as this segment was anomalously separated from the lower lobe almost forming a fourth right lobe. The result was excellent. In the second case there was an abscess involving small portions of both the right upper and middle lobes in the region adjacent to the fissure. This was excised *in toto* for immediate pathologic examination a malignant lesion being feared. A small empyema developed but healed after drainage and the patient is now working normally without symptoms. In these cases the mortality rate was 0 per cent complications occurred in 50 per cent and the present status is 100 per cent cured.

Lobectomy. As a result of aspiration and infection the inflammatory changes of lung abscess usually occur initially in one bronchopulmonary segment. Without prompt drainage lymphatic and bronchial spread will take place so that all the segments within a given lobe may become involved within a short time. Whereas it is frequently not necessary—drainage sufficing—and even inadvisable to resect a segment of a lobe the natural divisions of an entire lobe lend themselves admirably to excision. Thus the entire diseased region may be removed the inevitable regions of parenchymal destruction that result from attempted drainage at this stage are avoided and the patient is given a better chance of obtaining an asymptomatic cure. In 16 cases lobectomy was performed. There were complications in only 2 cases, in both of which resection was performed in 1938. Mass ligation technique was used at that time and bronchopleural fistula with empyema developed in each instance. Both fistulas were drained and after a

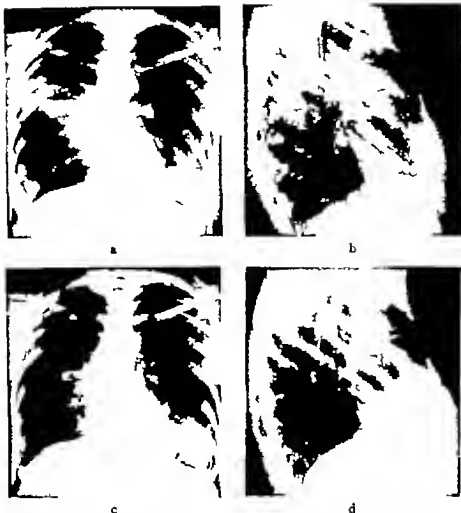


Fig 1 A case illustrative of what may happen when a chronic lung abscess with surrounding fibrosis and nonaerated lung is treated by open drainage. a and b Appearance of lesion immediately before open drainage 7 months after diagnosis. c and d Two months after open drainage. Note residual parenchymal scarring.

period healed completely. The patients are now asymptomatic having resumed their former work—one as a blacksmith, the other as a student. In these cases the mortality rate was 0 per cent, complications occurred in 12.5 per cent, and the present status is 100 per cent cured.

Bilobectomy. When the disease process has progressed to involve more than one lobe, it may be possible to resect the lower and middle lobes on the right side, preserving the function of the upper lobe. Bilobectomy may also be resorted to when the disease, although localized in one lobe, has involved a second by inflammation and adhesions so as to preclude the safe removal of one without the other. In 3 cases bilobectomy was performed in 1 for the technical reasons mentioned previous-

ly, and in 2 because of the extensive disease process. The patient in one of the latter cases died 48 hours after operation from shock with pulmonary edema. This patient had undergone open drainage of an interlobar empyema 1 month previous to resection. At final operation the lower and middle lobes were frozen in adhesions and an abscess was found perforating onto the diaphragm. The resection was difficult; contamination was widespread; 2,500 cubic centimeters of whole blood was given during operation and the ensuing 24 hour period and was supplemented by 2,250 cubic centimeters of intravenous fluid. An additional 2,300 cubic centimeters of intravenous fluid was given on the second postoperative day. It is quite possible that in the effort to overcome operative shock the pul-

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a



b



c



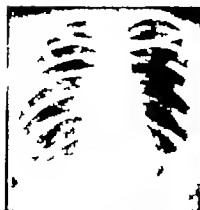
d

Fig. 3. a, Three years after open drainage. Bronchiectasis increasing. b, Patient returned because of spontaneous purulent drainage through scar of open drainage wound 4 years after operation. Elected pulmonary resection. c, After pneumonectomy. Total pneumonectomy was necessary because of extensive inflammatory change with adhesive pleuritis. d, Empyema developed necessitating thoracoplasty. Pleural cavity obliterated after 9 months drainage.

room in good condition but died suddenly in the elevator on the way to her room. It is possible that mediastinal flutter was responsible for this fatality although intrapleural pressures were determined and the mediastinum was adjusted to the preoperative state before the patient left the operating room as is our routine procedure. In this group of cases the mortality rate was 37.5 per cent.

Complications of those patients who survived operation were even more distressing. In 3 additional cases the patients died from brain abscess within 5 months of dismissal. One of these patients had experienced two Jacksonian seizures before operation and 1 died 5 months later after an unsuccessful

attempt to drain the cerebral suppuration. Whether metastasis to the brain had occurred before operation or as a result of operation in the 2 cases without preoperative signs of cerebral irritation is a matter of conjecture only. With the addition of these fatalities our mortality rate is revised upward to 56.2 per cent. In another 2 cases empyema developed. In 1 case it occurred 2 months after dismissal from the hospital. Repeated aspiration has obliterated the pleural space in 1; the other required open drainage and thoracoplasty and is still draining slightly. In a sixth case thoracoplasty was required within a year after operation because of cough and dyspnea from mediastinal shift and overexpansion of the



b



c

Fig. 1 and b. 5 months after open drainage. Patient returned because of hemorrhage. Not bronchiectatic changes in the anterior division of right upper lobe. After 1 month patient gained 30.3 and (13.6 kgm) seemed perfectly well and went through a normal pregnancy c and d. 7 and half years after open drainage patient experienced high fever, chill, and pleuritic cough. Not increased damage to lung.

monary edema found at postmortem examination was produced. In these cases the mortality rate was 33.3 per cent, complications occurred in 0 per cent, and the present status is 66.7 per cent cured.

Summary of these 21 cases in which conservative resection could be carried out reveals a mortality rate of 4.8 per cent and a complication rate of 14.3 per cent. The complications responded to appropriate treatment. Thus in 20 of the 21 cases the final result was an asymptomatic cure.

These results are in sharp contrast to the following obtained by pneumonectomy. When infection has been permitted to ravage an entire lung with the production of varying degrees of fibrosis, bronchiectasis, bronchosteno-

sis and atelectasis, resort to surgical treatment becomes in many instances a last-ditch stand.

Pneumonectomy. In the remaining 16 cases total pneumonectomy was performed. There were 6 postoperative deaths, 3 within 24 hours from shock, the fourth within 4 days from a stroke, necropsy revealing an infarct in the left hemisphere of the cerebrum. The fifth patient died on the table from hemorrhage. This patient had undergone 5 previous operative procedures elsewhere, including several open drainages and a six rib thoracoplasty. In these 5 cases pneumonectomy was performed more than 3 years ago. In 2 of them more than 5 years ago. In the sixth case pneumonectomy was done recently. The patient, a child aged 6 years, left the operating



a



b



c



d

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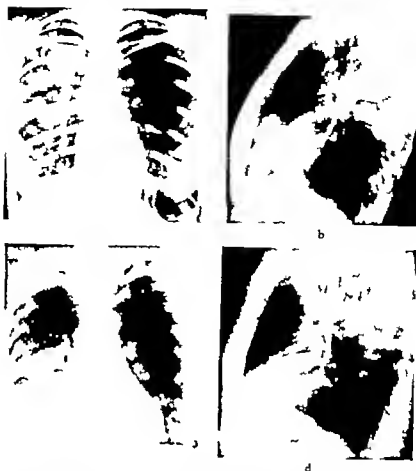


Fig. 4. a and b. Posteroanterior and right lateral roentgenograms showing multiple lung abscesses. The upper abscess in the posterior segment of the right upper lobe is filled with inspissated debris; the lower abscess in the superior division of the right lower lobe has evacuated itself. Pneumonectomy was performed with excellent result. c and d. Posteroanterior and right lateral roentgenograms revealing a lung abscess with bronchoasthenosis, atelectasis, and fibrotic changes. Right middle lobectomy as performed with excellent result.

contralateral lung. Complications occurred in 37.5 per cent of the cases in which pneumonectomy was performed.

The marked discrepancy in results between these two groups is obvious. It cannot be explained on the basis of magnitude of operative procedure alone for such results are at marked variance to our approximate over all 2:1 mortality ratio for pneumonectomy versus lobectomy. We believe the crux of the situation lies in the preoperative condition of the patient. The individual who has lost the function of an entire lung because of widespread suppuration and has been subjected to a long period of toxicity and debility will inevitably undergo extensive surgical manipulation with

greater risk. If such is the course of conservatism it becomes paradoxical and should be regarded rather as the more radical approach. The basic principle of attacking irreversible tissue damage early before vital body reserves are depleted should remain inviolate.

COMMENT

The trend in very recent years in the treatment of chronic lung abscess has been away from open drainage and toward pulmonary resection. From 1921 to 1937 the mortality rate for drainage in this type of case ranged between 21 and 45 per cent (12). More recently a number of reports have appeared stressing the rationale of excision pointing out

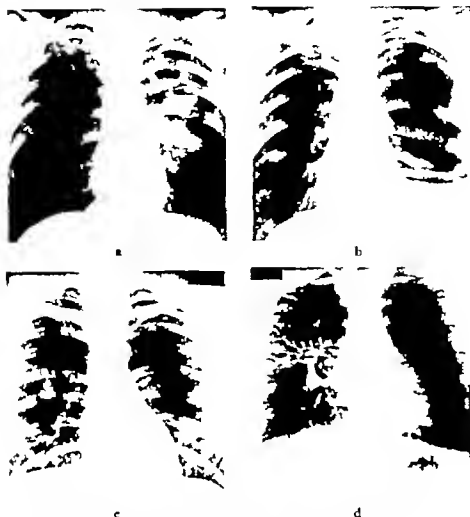


Fig. 6 a, Multilocular abscess in the posterior segment of the left upper lobe. b, Roentgenogram after left upper lobectomy. Patient dismissed on fourteenth postoperative day. c, Lung abscess located in the superior segment of the right lower lobe. d, Bronchogram showing lipiodol filling abscess cavity. Segmental resection of superior portion of right lower lobe was performed with excellent result.

that in spite of the poor condition of the patient resection particularly lobectomy can be accomplished with a low operative risk and with a much higher percentage of asymptomatic cures (17-11). Landskog (13) in 1944 presented a series of 24 resections with excellent results. Of 14 patients who underwent primary lobectomy 1 died a mortality rate of 7.1 per cent. Twelve obtained good results and 1 was still under treatment. Of 10 secondary resections there were no operative deaths, 2 patients dying later of brain abscess and streptococcal sepsis. Our results are in complete accord with these observations and we feel that they present additional arguments in favor of regarding lung abscess as a surgical problem from the outset.

The statement has been made repeatedly in the literature that 25 to 30 per cent of lung abscesses will clear by medical means alone. We agree with this premise but as the course of any given case is unpredictable it is felt that surgical consultation should be sought from the outset so that the optimal time for intervention may not be overlooked. The relationship between drainage and resection will in time under these circumstances become clear. Resection should supplant drainage as long as cases of lung abscess are presented to the surgeon. In the chronic or complicated stage as has been true in great measure to date. Should the patient be seen early and the lesion be found to be localized without evidence of widespread secondary changes (fibro-

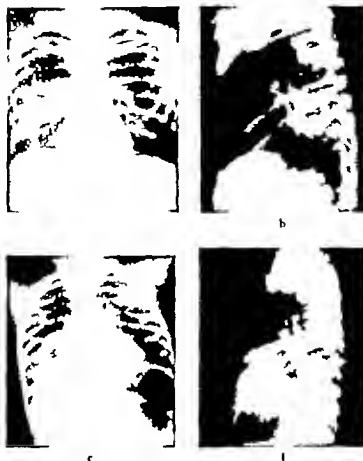


Fig. 7. (a) Posteroanterior and lateral roentgenogram showing abscess in the right lower lobe of child aged 6 years. Abscess had been present 1 year. Right lower lobectomy was performed with excellent result. (c) and (d) Posteroanterior and lateral roentgenogram of thorax 4 months later. It spirals of crushed peanut from bronchoscopy attempt 1 led to removal of pus at right lower lobectomy dismissal on tenth postoperative day.

4. bronchiectasis bronchostenosis atelectasis) open drainage is the reasonable procedure. Under this management time and thorough follow up with bronchography alone will determine whether the parenchymal fibrotic scar resulting from drainage will remain a future source of bronchiectatic change with its pooled secretions and attendant symptoms. In the latter eventuality resection will replace open drainage in all forms of lung abscess except those in which the disease is fulminating and drainage becomes a life-saving procedure.

INDICATIONS FOR PULMONARY RESECTION

At present our indications for pulmonary resection in cases of lung abscess are

1. Persistent symptom due to pathologic changes secondary to open drainage.
2. Multiple or multiple abscesses.
3. Abscesses associated with secondary changes such as fibrosis bronchiectasis bronchostenosis, or atelectasis.
4. Abscesses so located anatomically as to be inaccessible to adequate drainage.
5. Abscesses in which the diagnosis of malignancy is entertained.
6. Abscesses associated from the onset with excessive bleeding.
7. Abscesses in children.
8. Abscesses secondary to foreign bodies unretrievable by bronchoscopy.

In this respect our experience has been similar to that of Landskog and Woods and McCraith.

1 Persistent symptoms of cough expectoration or hemorrhage obviously indicate the presence of residual or superimposed infection in regions of fibrosis and ectasia resulting either from undrained regions of the original disease process or from the traumatic sequelae of surgical drainage. Were all lung abscesses treated by open drainage followed at intervals by bronchography we have no doubt that a large percentage would reveal bronchial and parenchymal distortion and dilatation. When such conditions prevail resection affords the only lasting form of treatment. Such a case is illustrated in Figures 1, 2 and 3.

2 Multiple or multilocular abscesses as a rule indicate such extensive irreversible damage that resort to surgical procedures short of resection is an invitation to continued bronchiectatic symptoms (Fig. 4a and b and Fig. 5a frontispiece).

3 Those abscesses which are seen by the surgeon for the first time after the secondary changes of fibrosis bronchiectasis bronchostenosis or atelectasis have developed will not be relieved by any treatment other than resection. Surgical drainage is designed to evacuate cavities but cannot be expected to influence widespread parenchymal degenerative and reparative processes (Fig. 4c and d).

4 There are many abscesses so located within the lung that even though they are in contact with parietal pleura at some point adequate drainage cannot be maintained because of overlying structures such as the scapula. In addition a number of abscesses which present on the mediastinal interlobar or diaphragmatic pleural surfaces are more suitable for resection than for drainage. In some of these cases it may be in order to attempt drainage primarily reserving excision for a time when the extent of the underlying pathologic changes may be more clearly demonstrated (Fig. 6a and b and Fig. 5b frontispiece).

5 Although this paper is not primarily concerned with abscesses secondary to a malignant lesion it is strictly in order to comment that particularly in patients more than 40 years of age when such a diagnosis is entertained the only procedure tenable is exploration and resection.

6 In 19 of the 37 cases in this series hemoptysis of some degree was present from the onset of the disease. In 6 it occurred repeatedly in profuse amounts and we believe that this symptom alone regardless of the extent of the associated pathologic changes is an indication for resection. There have been many reports of fatal hemorrhage following open drainage for lung abscess and it is our feeling that forewarned should be forearmed for in such cases in all likelihood the hemorrhagic trend will continue (Fig. 6c and d and Fig. 5c frontispiece).

7 There may be some controversy over including all lung abscesses in children in the list of absolute indications for pulmonary resection. Our experience has suggested that such a course is reasonable on several grounds. First children tolerate resection extremely well. Second, there is some evidence that regeneration and compensation occur in the remaining lobes, if we may apply the experiments of Longacre and Johansmann on animals to human beings. Third it is felt that should regions of parenchymal damage remain after drainage they may be the source of continued infection and the focus from which additional lung damage may arise as the child grows older. Fourth long continued drainage is frequently difficult to manage especially in the very young, and as such may be inadequately cared for by parents and physician alike (Fig. 7a and b).

8 Occasionally experienced bronchoscopists are unable to remove an aspirated foreign body from the depths of the small bronchial radicals. Especially is this true when crushed pieces of peanuts or other food particles have been insufflated. Abscesses on this basis are best resected to insure the removal of the foreign body (Fig. 7c and d). In 2 cases in this series large foreign bodies in the form of a piece of fall grass and a bone were aspirated unknown to the patient and were found only on dissection of the specimen (Fig. 5d frontispiece).

SUMMARY

In 37 cases primary lung abscess in various stages of chronicity was treated by pulmonary resection. The elapsed time from the origi-

nal diagnosis to surgical excision averaged 18 months. In the 21 cases in which a conservative resection (lobectomy or less) could be performed there was 1 death (mortality rate 4.8 per cent) despite the wasting and general debility of the patients when admitted for treatment. In the remaining 20 cases the results were good and are regarded as asymptomatic cures. In contrast of the 16 cases in which total pneumonectomy was performed in only 7 was a good result obtained and in 3 of these it was delayed considerably by complications. There were 6 deaths attributable to operation (mortality rate 37.5 per cent) and 3 late deaths resulting from brain abscess.

We believe that if the problem of acute lung abscess is considered as surgical from the outset and the optimal time for intervention is recognized and acted on with dispatch the problem of chronic lung abscess will virtually be eliminated. Until such a time pulmonary resection is the treatment of choice for supuration of long standing. It is our opinion that bronchographic follow up of patients treated by open drainage will reveal that a significant number are left with residual parenchymal and bronchiectatic changes, which in all probability will lead to further symptoms at some future date. This is especially true when abscesses are drained in the chronic state or after secondary changes have taken place. For this reason pulmonary re-

section should take preference over open drainage in most cases seen by the surgeon at the present time.

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THE BRONCHIAL ARTERIES

An Anatomic Study of 150 Human Cadavers

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THIL bronchial arteries which provide the systemic nutrient supply to the lungs have been studied in their intraparenchymatous course by many anatomists and physiologists¹ but their gross topography has been inadequately considered in systematic studies of human angiology. The relative inaccessibility of these vessels makes them difficult to demonstrate in the dissection's routine anterior approach to the thoracic viscera and only when abnormally affected are they observed at the autopsy table. Consequently the literature is replete with conventionalized descriptions but neither detailed nor comprehensive information is available.

These vessels were known to Galen from dissections on sub-human types but were not specifically named (Miller 1906). Their identity was denied by Columbus (1559) and reaffirmed by Marchettus in 1656. The discovery of the bronchial arteries as vascular conduits separate from but anastomosing with the pulmonary system was claimed by Ruysch in 1721. His description however represents a rediscovery with a more accurate text and the first illustrations of the arterial distribution. Accurate descriptions of their origin and course and some of the variations in pattern are to be found in Albertus Haller's *Icorum Anatomicarum* (1747); this account represents a heritage little modified in subsequent treatises of anatomy and surgery. The monographs of Fickel (1743) and Susloff (1895) are relatively unknown to the student and are not readily accessible. The accounts of Boyer (1815) and Bichat (1819) closely follow that of Haller and are more adequate than many

appearing in later texts. In Tiedemann's excellent *Tabularum Arteriarum* (1822) bronchial arteries are portrayed as arising from the concavity of the aortic arch and from the proximal portion of the descending aorta and coursing anterior to the trachea to the corresponding surface of each primary bronchus. This most unusual pattern has been uncritically copied into a succession of standard works by Cloquet (1825), Smith (1835), Galet (1853), Quain (1866), Hoffmann (1878), Testut (1911), Rauber Kopsch (1919) and Morris-Schaeffer (1942) despite the fact that it is inconsistent with the accompanying texts. Modern anatomy books perpetuate Haller's account of variations in origin of the bronchial arteries so that the right subclavian, superior intercostal, inferior thyroid and internal mammary arteries are regularly included in the discussions of anomalous sites of origin. Original reports of variable origin of these vessels other than undocumented textbook statements have implicated the right subclavian (Haller 1747, Henle 1876, Fredenc 1897, Menke 1936), the left subclavian (Meyer 1857, Turner 1862, Hewitt 1930, Schneider 1934), the internal mammary (Zagorsky 1834, Quain 1844, Fredenc), the superior intercostal (Ruysch, Quain, Luschka, 1863, Poupartin 1909) and the innominate (Quain, Romankevich 1931).² Origins of bronchial ar-

¹Several descriptions in the literature are ambiguous. The bronchial artery patterns in cases reported by Jacobson (1866) and LeGros Clark (1897) may be variably interpreted. Jacobson (cited by Christeller) presented a case of congenital heart disease with dilatation of the bronchial arteries and of a branch described as the superior pericardiac artery; whether the latter vessel represents an anomalous bronchial artery or an abnormally dilated anastomosis between the bronchial and pericardiophrenic arteries is not clear. LeGros Clark likewise described a case of congenital heart disease with dilatation of the bronchial arteries and "the branch from the internal mammary artery which accompanies the phrenic nerve was nearly equal in size to the parent trunk, and expended itself principally in the adjacent adherent lung." This was interpreted as an anomalous bronchial artery by Hovelacque, but as in the former case, may merely represent a dilated pericardiophrenic artery; an anastomotic relationship with the bronchial vessels. (Continued on next page.)

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For a discussion of the intrinsic anatomy of the bronchial arteries the reader is referred to Miller's classical monograph on *The Lung* (1911). A brief historical survey of the problem of bronchial and pulmonary arterial relationship is provided by Berry Brunsford and Daly (1931).

teries from the distal portion of the thoracic aorta have recently been reported by Schall (1926) and Natucci (1939) and from the abdominal aorta by Cioni (1939).² A critical examination of these cases indicates that the vessels described represent anomalous pulmonary rather than bronchial arteries. Anomalous pulmonary arteries constitute surgically important structures and have been specifically described by McCotter (1910) who reviewed the literature to 1777 Batts (1939) Harris and Lewis (1940) and Arce (1943).

In 1924 Nakamura examined the thoracic aortae of 129 cadavers to determine the sites of origin of the bronchial arteries but the restricted topographic nature of the study obviated a consideration of vascular patterns. He classified bronchial arteries on the basis of origin into 3 major types: Type A, arteries arising directly from the aorta (33 cases); Type B, arteries arising in part directly in part indirectly from the aorta (103 cases); and Type C, arteries arising indirectly from the aorta (3 cases). Hovelacque, Monod and Evrard (1936) described the course and distribution of these vessels, and illustrated some variations in pattern without tabulating any portion of their data.

The comparative anatomy of the bronchial arteries is represented by studies on the dog (Kuttner 1878 Miller 1925 Berry Brailsford and Daly 1931) and guinea pig (Willis, 1919) based principally on injection preparations (see footnote 3).

Fickel (743) described common bronchial artery to both lungs arising from subclavian, whose side, however, was not specifically given. It may be assumed, from the context, to have been the left.

Turner (263) described case of right aortic arch, and anomalous site of origin of the left subclavian and left bronchial arteries from retroesophageal pouch like trunk rising from the left side of the descending part of the arch. In contrast, Zagorsky (834) described right subclavian from the left side of the aortic arch. The anomalous subclavian gave rise to vertebral artery which in turn provided common trunk for internal mammary and deep cervical arteries. The right bronchial artery arose from the aberrant internal mammary vessel.

Highly aberrant forms appear in the older literature: common trunk from the abdominal aorta immediately proximal to the celiac axis ascends through the esophageal hiatus to bifurcate and supply the lower lobes of both lungs (Mansueto, 80). Trunk arising from the celiac axis is common with the right phrenic plexus through the esophageal hiatus to bifurcate and supply the dorso-lateral aspect of both lungs (Heyfelder, 443).

Brown (911) illustrated right accessory pulmonary artery from the right inferior phrenic artery in cat. Winogradsky (990) described anomalous origins for these arteries from the abdominal aorta in the dog and martin. This is apparently the normal vascular pattern in reptiles (Hinkle, 876).

The embryology of these arteries has not been subjected to systematic study and our present information is chiefly speculative in character.⁴

It has been long known that alterations in the physiology of the pulmonary arterial circulation have an effect on the bronchial arterial system. Virchow (1851) demonstrated that long standing obstruction of a pulmonary arterial branch to one lobe led to dilatation of the bronchial arteries and the participation of the bronchial arteries in the pathologic processes resulting from pulmonary stenosis and atresia has been more recently described by Christeller (1917) East and Barnard, (1937), Schopper (1938) and Greenspon and Leamas (1939). Christeller reviewed a series of 35 cases, collected from the clinical literature between 1815 and 1905 emphasizing the function of the bronchial arteries in collateral circulation of the lung in the presence of pulmonary artery obstruction. With the impetus provided by Miller's work on the intrinsic an-

According to Evans (900) nothing has been ascertained concerning the development of the bronchial arteries, and examination of the literature after 900 reveals no specific work on the embryology of these vessels. Because of the close relationship of bronchial arteries to intercostal arteries, arising in company with the latter or from corresponding portions of the thoracic aorta, clues to the embryonic origin of the right bronchial vessels may be gained by consideration of intercostal artery development.

Dorsal sprouts emerge strictly intersegmental pulsed from the primitive duplicated and unbranched descending aorta, and course in the planes between prebifurcative segments to vascularize the spinal cord and ganglia, and eventually the body wall. Avascular position of the aortae results in their emergence by pairs. The definitive intercostal arteries are secondary derivatives of the original dorsal segmentals, and so outstrip them in growth that in the postnatal body they themselves are identified as the main branches, the original segmentals seeming to be merely their posterior rami.

Atrophy of the proximal cervical dorsal segmentals leaves the seventh segmental as the permanent trunk of origin of vertebral and subclavian arteries, the seventh segmental, though it supplies intercostal branches, functions as root of origin for the eighth cervical and first thoracic arteries. The next permanent dorsal segmental behind the subclavian is the second or third thoracic; hence, the first intercostal supplies either or both of these intertruncs.

The association of bronchial arteries with right intercostals, and occasionally with the subclavian and internal mammary arteries, would suggest secondary development of the pulmonary arterial system from the lower cervical and upper thoracic dorsal segmentals (intercostals), and from the ventral aspect of the aorta during the course of, and subsequent to, the descent of the lung into the future thoracic cavity.

The proximity of the aortic arch to the root of the left bronchus would permit easy access of visceral branches from the right to the left main bronchus (see Table I, A). The right main bronchus is accordingly separated from its aortic source by greater interval and is in closer relation to aortic branches instead, to right intercostal arteries (see Table II). The final answer to the interesting question of bronchial artery origin must await further embryologic study.

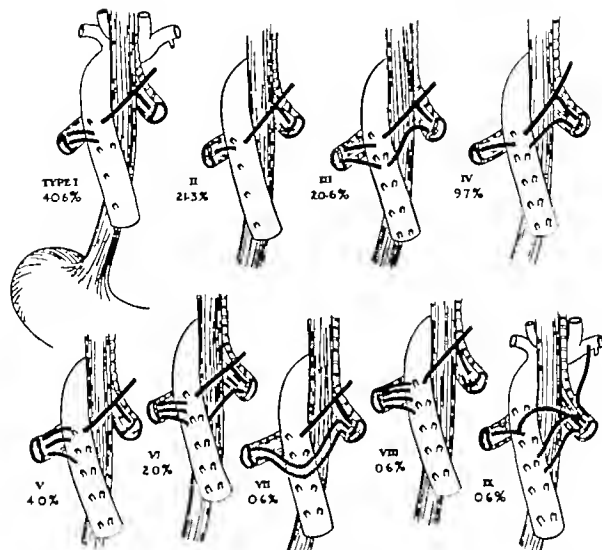


Fig. 1. Types of bronchial arterial supply 150 cadavers classification based upon origin, number and course of the vessels. Semidiagrammatic dorsal aspect.

tomic relationships of pulmonary and bronchial arterial systems, important studies were conducted on the pathologic physiology of the bronchial circulation by Mathes Holman and Reichert (1930-1932) and by Wood and Miller (1938). These authors found a consistent dilatation of the bronchial arteries in acute and chronic inflammatory processes involving the pulmonary parenchyma³ in primary carcinoma of the lung in congenital cystic disease of the lungs and in pathological and surgical occlusion of the pulmonary artery to a lobe. Following a pulmonary embolus, the

In the current series, it was observed that the bronchial arteries to lungs showing caseous necrosis and cavitation (presumably tuberculous) were increased in size in comparison with those from specimens free of gross pulmonary disease. There is specific dilatation of an artery to a particular lobe when that lobe alone is grossly involved.

bronchial arteries serve the important function of filling the circulatory beds distal to the embolus and in the presence of infection provide increased nutriment to the involved lung by virtue of its dilatation (Mathes *et al.* 1932). The participation of the bronchial arteries in traumatic affections of the mediastinum (Latimer and Willems 1928) and in syphilitic arteritis (Jacobi 1931; Pinard, Corcos and Lemoine 1937) has also been reported. In Jacobi's case there were multiple saccular aneurysms of the left bronchial arteries.

The bronchial arteries are encountered by the thoracic surgeon in the course of lobectomy or pneumonectomy but ordinarily they constitute no great obstacle to the technique (Blades and Kent 1940; Kent and Blades

TABLE I — TYPES BY NUMBER (150 CASES)

Type	Number of Arteries		Cases	Percent
	Left	Right		
I			2	
II			3	1
III			10	
IV				
V				00
VI				00
VII				
VIII				
IX				

1942). However their dilatation subsequent to inflammatory processes in the lung or in concurrence with congenital or pathologic destruction of the pulmonary circulation may make of these vessels hazards to be reckoned with in surgical manipulation. Certainly knowledge of their varied origins and distribution would provide a practical addition to the operator's armamentarium.

MATERIAL AND METHODS

The current study is based upon dissections of 150 adult male and female cadavers, white and negro. A posterolateral approach to the mediastinum is employed. With the body in the prone position muscles of the 9th intercostal space are transected and the parietal pleura separated as each rib (from 9th to 2nd) is successively removed by sectioning them 2.5 centimeters lateral to the costovertebral junction and along the midaxillary line. The parietal pleura is then incised along the thoracotomy like opening and removed. This procedure provides an adequate exposure of the posterior mediastinum. Subsequent dissection removes the pleura from mediastinal viscera, and exposes the bronchial arteries.

The bronchial arteries are usually first encountered as they course on or near the membranous portion of the main bronchi. When identified they are dissected proximally to

*One case of complete atresia of the bronchial artery was encountered in the course of study making a total of 5 cadavers. This specimen is discussed separately, however and is not included in the tabulation of data.

TABLE II — RIGHT INTERCOSTOBRONCHIAL ARTERIES (133 CASES)

	Cases	Percent of Cases	Percent of Total
I. First intercostal artery		1.00	1%
2nd intercostal		25	6%
3rd and 2nd intercostals		2.00	4%
1, 2nd and 3rd intercostals	3	25	10%
2nd intercostal	27	51	19.5%
2nd and 3rd intercostals		2	1%
2nd, 3rd and 4th intercostals		25	
3rd intercostal	3	6.3	24.0%
3rd and 4th intercostals		2.00	1%
Second aortic intercostal artery		1	2.15
3rd intercostal		2	1%
3rd and 4th intercostals		25	10%
4th intercostal	5	00	3%
5th intercostal		25	1%
Th. 3 aortic intercostal artery		1	1%
4th intercostal	1		1%
1st and 2nd and 3rd intercostals	2		00
(1) 2nd and (1) 3rd intercostals			00
(1) 3rd and (1) 4th intercostals		25	1%
(1) 2nd and 3rd, (1) 3rd and 4th intercostals		25	1%
2nd and 3rd aortic intercostal		2	6%
3rd and (1) 4th intercostals	1	25	1%
		100.00	100%

their origin and finally into the hilum of the lung.

Representative specimens are chosen for illustration. For the purpose of clamping vascular structures are sometimes totally removed, and the trachea and great vessels mobilized to expose fully the course of the arteries. Typical examples of each variational type are shown semidiagrammatically in Figure 1 (I to IV).

OBSERVATIONS AND DISCUSSION

The bronchial arteries take origin with but few exceptions from the proximal part of the thoracic aorta arising independently in multiples from a common stem or in company with a functionally unrelated vessel. For convenience in description these vessels are tabulated quantitatively into types (Table I) into modes

TABLE III — MODE OF ORIGIN OF BRONCHIAL ARTERIES (150 CASES)

	Cases	Per cent
A. Separate origin from the aorta (and branches)		74
B. Common trunks from aorta (and branches)	30	20
One left and one right artery	24	4
a. Inferior left and inferior right		7.3
b. Superior left and inferior right	9	6
c. Single left and inferior right	1	3.3
d. Single left and single right	4	7
Superior left and superior right	2*	3
f. Superior left and single right		7
g. Inferior left and single right		7
h. Single left and one (2nd of a) right		7
Two left and one right	3	
T. Left and single right		3
h. T. Left and inferior right		7
3. Two common trunks		3
	50	100

*Interbronchial trunks considered as separate vessels
 *One of these arises from the left subclavian

of origin (Tables II and III) and their approximate level of emergence from the parent trunk is recorded in topographic relationship to the thoracic vertebrae (Tables IV A and IVB)

Origins The more commonly encountered pattern Type I in Figure 1 (40.67 per cent Table I) is that described as normal in standard textbooks. In these specimens two left and one right bronchial arteries are present. In every case there is at least one bronchial artery to each lung and this simplest vascular scheme occurs next in order of frequency as Type II (21.33 per cent). The third major group Type III is characterized by bilateral duplication of the arteries (20.67 per cent of cases). These three types comprise 82.67 per cent of the arterial patterns in all cadavers studied.

In 14 cases (Type IV 9.33 per cent) the pattern is the reverse of Type I with one artery to the left and two to the right lung. The arteries to the left lung are increased to 3 with a single vessel persisting on the right side in 6 cases (Type V 4.0 per cent). A maximum number of 5 arteries is encountered in 6 cases (4.0 per cent). Of these 3 specimens pos-

TABLE IV A — VERTEBRAL LEVEL OF ORIGIN BY CASES (150)

Origin	Left		Right	
	Cases	Per cent	Cases	Per cent
A. Arch of aorta	20 ^a	3.3	6 ^b	4
T ₃		7		
T ₄	3	8.7	5	3.3
T ₅	5 ^d	3.3	4	7
T ₆		7		
B. Subclavian	3		3	
Left	2 ^e	3	2 ^e	7
Right		0		7
C. Descending aorta	5	100	57	38
T ₄	4	7	3	
T ₄ & 5	2	5.3		3
T ₄ & 6	3			
T ₅	20	7.3	8	
T ₅ & 6	35	26.7	4	7
T ₅ , 6 & 7	3	3.3		
T ₅ & 7		7		
T ₆	5	6.7	6	7.3
T ₆ & 7	18			
T ₆ , 7 & 8	3			
T ₇		2	4	7

Exclusive of interbronchial trunks (see footnote 5)

Includes 4 common stems.

Includes 3 common stems.

Includes common stem.

Includes common stem.

TABLE IV B — VERTEBRAL LEVEL OF AORTIC ORIGIN BY ARTERY*

Level of origin	Left		Right	
	Number	Per cent	Number	Per cent
T ₃		4		
T ₄	24	9	7	9
T ₅	80 ^d	31	2 ^d	24.4
T ₆	2 ^e	46.9	31 ^e	45.4
T ₇	20 ^e		4 ^e	6.3
T ₈		4		
	260	100	64	100

Exclusive of interbronchial trunks.

From the anteroposterior aspect of the aortic arch.

Five common trunks, 3 providing one vessel to each side, dividing into left and right vessels.

*Twelve common trunks, of which divided into left and right artery.

Two common trunks.

sess 3 left and 2 right arteries (Type VI 2 per cent) and a single case demonstrates the reversed scheme (Type VII 0.67 per cent). The

remaining 2 examples have four arteries to one lung and a solitary vessel to the opposite organ. The quadruple pattern is found on the left in Type VIII (0.67 per cent) on the right in Type IX (0.67 per cent).

On the basis of sides two thirds of all right lungs are supplied by a single bronchial artery (100.67 per cent) whereas about one third of left lungs are so supplied (47.318 per cent). On the other hand 62 per cent of all left lungs are provided with two bronchial arteries, while half that number (32 per cent) of right lungs have duplicated vessels. Three arteries to the left lung are observed in 9 bodies (6 per cent) and to the right lung in but 1 instance (0.67 per cent). Four arteries supply a right and a left lung in separate cases (Table I).

Classification of bronchial arteries into types on the basis of pattern frequency may be supplemented by a consideration of the manner of origin of the vessels represented.

Type I. Two left, one right (61 cases 40.67 per cent)

- A Each arises separately (58.487 per cent)
- B Superior left and single right from common stem (1.06 per cent)
- C Inferior left and single right from common stem (0.6 per cent)
- D All three from common stem (1.06 per cent)

Type II. One left, one right (33 cases 21.33 per cent)

- A Each arises separately (58.187 per cent)
- B Both from common stem (4.57 per cent)

Type III. Two left, two right (31 cases 20.67 per cent)

- A Each arises separately (9.6 per cent)
- B Inferior left and inferior right from common stem (9.6 per cent)
- C Superior left and inferior right from common stem (8.53 per cent)
- D Two common stems (2.1 per cent)
- E Superior left and superior right from common stem (1.1 per cent)
- F Two left and inferior right from common stem (0.6 per cent)

Type IV. One left two right (14 cases 9.33 per cent)

- A Each arises separately (9.6 per cent)
- B Single left and inferior right from common stem (5.33 per cent)

Type V. Three left, one right (6 cases 4 per cent)

- A Each arises separately (5.2 per cent)
- B Superior and middle left, single right from common stem (1.1 per cent)
- C Inferior left and single right from common stem (1.067 per cent)

Type VI. Three left, two right (3 cases 2 per cent)

- A Each arises separately (1.067 per cent)
- B Superior left and inferior right from common stem (1.067 per cent)
- C Inferior left and right from common stem (1.067 per cent)

Type VII. Two left three right (1 case 0.67 per cent)

- Two common stems superior left and middle right, inferior left and right.

Type VIII. Four left, one right (1 case 0.67 per cent)

- Each arises separately

Type IX. One left, four right (1 case 0.67 per cent)

- Superior right from right subclavian, middle left and second right from common stem, third and fourth right arise separately.

The bronchial arteries to the right lung differ markedly from those to the left in respect to sites of origin from the aorta. Those to the right side arise from the corresponding lateral or dorsolateral aspect of the aorta, in the former position when separate and in the latter position separately or in combination with an intercostal. When this last named arrangement occurs, the point of origin is in longitudinal alignment with the remaining intercostal arteries (Fig 1). In cases with single right arteries this pattern obtains consistently. It does not occur regularly in cases with multiple right vessels in such specimens the superior bronchial artery is likely to arise in common with an intercostal while the inferior bronchial originates from the anterior surface of the aorta. In no case does a right bronchial artery arise from the left side of the aorta.

A right bronchial artery frequently arises in common with an intercostal artery. The term *intercostobronchial* is hereinafter applied to these vessels in order to obviate artificial and confusing distinction between parent stem and branch in the majority of cases but the difference in size is observed between the components of the bifurcated vessel. Where as embryologically the intercostal artery holds primary position (see footnote 4) the right bronchial artery is frequently of greater size than the related segmental vessel (Fig 4). The fact that the right bronchial artery frequently arises in common with an intercostal has been long known. Ruysch and Haller described this relationship. However confusion has resulted from failure to indicate accurately the intercostal vessels associated with this

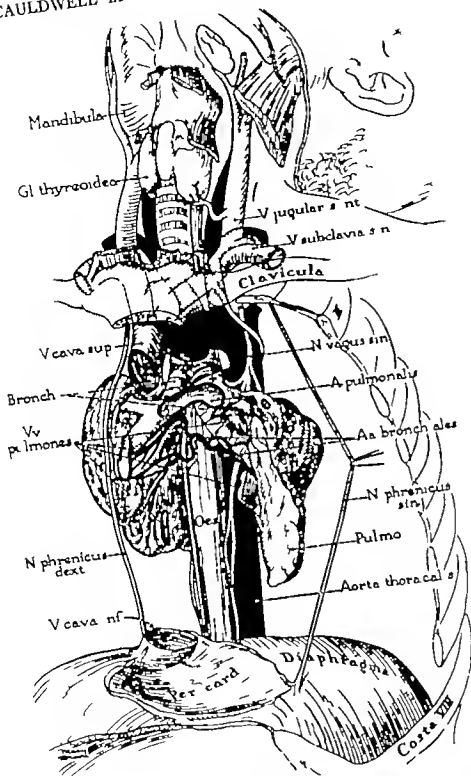
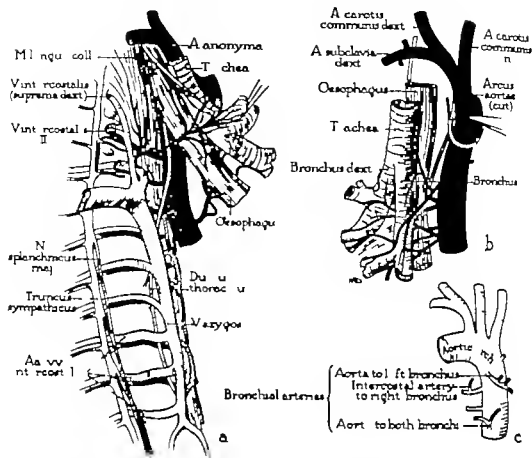


Fig. 2. Bronchial arteries and related structures (Specimen A). Deep thoracic structures viewed from an anterior and slightly lateral position. The thorax has been opened by cutting away the body and xiphoid process of the sternum and the ribs from the first through the seventh. Within the thoracic cavity the following structures have been removed: pleura, heart and pericardium inferior vena cava and azygos vein, both lungs except in their hilar portions. The phrenic nerves are retracted; the ligamentum arteriosum is indicated by a cross. In this way the following ves-

sels, viscera and nerves (pertinent to the current study) have been exposed: trachea and bronchi, vagus nerves, esophagus, thoracic aorta and bronchial arteries. The bronchial arteries (Type II) arise by a common stem, one division passing to each bronchus. The right bronchial vessel crosses anterior to the esophagus, to ramify on the anterior and inferior surfaces of the corresponding bronchus. The vessel of the left side courses almost directly forward at the inferior margin of the left bronchus, ramifies then pass to the anterior surface.



Figs 3a to 3c. Bronchial arteries and related structures (Specimen B). Figure 3a, an oblique view from the front and right. Figure 3b, obliquely viewed from the opposite side. Figure 3c, diagram of the bronchial and intercostobronchial sources (Type III) from the front. In Figures 3a and 3b the aorta has been removed except in the tracheobronchial area. In Figure 3a the arch of the azygos vein has been transected and this vein turned laterally, right bronchus has been pulled forward, as has also the esophagus, to demonstrate the vessels sent from the intercostobronchial artery to the right bronchus and the vessel of aortic origin which bifurcates to supply both bronchi. In Figure 3b the aorta has been retracted to show in addition to the arteries just described, left bronchial vessel. On each side ramify from the chief sources do not merely course distalward with bronchus, but also turn proximalward to supply the trachea. Some branches are given off to the esophagus (Fig 3b).

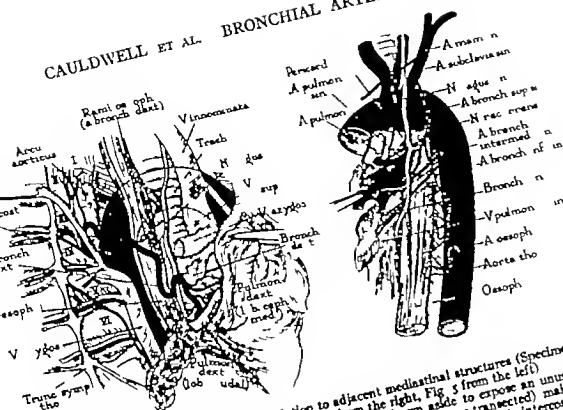
pattern. Many authors of textbooks classify the segmental arteries on the basis of the intercostal spaces supplied (posterior intercostal arteries); others identify them more satisfactorily on the basis of their relative position as aortic derivatives (aortic intercostal arteries). To provide needed information of accurate nature and incidentally to indicate the discrepancies which can arise from the designation of posterior intercostal arteries as reference sites data have been tabulated on the right intercostobronchials (Table II).

One or more right intercostobronchial arteries are found in 133 cadavers (88.7 per cent

Table II). A right bronchial artery is associated with a single intercostal in 129 cases (86 per cent). In 4 cases (2.7 per cent) each of 3 right bronchial arteries arises in common with an intercostal; in 3 in common with the first and second aortic intercostals and in 1 with the first and third. In 17 cases (11.3 per cent) the right bronchial arteries are in no way associated with intercostals; they arise from the aorta or subclavian⁷ either separately or

Winkel (1835) describes branches from the subclavian as corresponding internal mammary arteries as "superior bronchial arteries." Other authors generally refer to these as "accessory bronchial" or "anterior bronchial" arteries in contrast to "posterior" or "inferior" vessels; the latter terms referring to the usual arteries of aortic or intercostal origins.

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Figs. 4 and 5. Bronchial arteries in relation to adjacent mediastinal structures (Specimen C and D, respectively). Anterolateral views (Fig. 4 from the left, Fig. 5 from the right). In Figure 4, left, the upper lobe of right lung has been drawn aside to expose an unusually large intercostobronchial artery beneath the arch of the azygos vein (here transected) maintaining its diameter as the right bronchial and continuing as an attenuated first aortic intercostal. In Figure 5, all pulmonary tissue has been removed to show the two left bronchial arteries of direct aortic origin and an unusual left superior bronchial arising from the subclavian (Type V). In addition to its supply to the left superior lobar bronchus, the left superior bronchial artery sends a descending ramus along the corresponding surface of the esophagus, thus supplying the supply of direct aortic and intercostal derivation.

in company with other right or left bronchial vessels.

Of an overall total of 205 right bronchial arteries (to 150 right lungs) 137 (66.8 per cent) in 133 cases are components of intercostobronchial trunks. The remaining 68 vessels (33.2 per cent) occurring in 60 cases, are unrelated to the intercostal vessels.

The right bronchial and first aortic intercostal arteries are derived from a common stem in 117 cases. This represents 78 per cent of total cases (150) or 88 per cent of those (133) demonstrating intercostobronchial relationship.

The first aortic intercostal spaces from first to fourth as solitary or combined trunks. In 82 cases supplies intercostal spaces from first to fourth as solitary or combined trunks. In 82 (of 117) cadavers a single intercostal space most vascularized the third being the space most commonly supplied in this manner (Table II). In 31 (of 117) cases, an intercostal artery bifurcates distal to its emergence from an intercostobronchial stem to supply two adjacent interspaces the second and third spaces being

those most frequently cared for in this manner. In only 4 cases (of 117) are 3 adjacent interspaces supplied by a single derivative of an intercostobronchial artery.

The second aortic intercostal artery is associated with a right bronchial in 11 cases (7.33 per cent of 150) 8.25 per cent of 133. The second aortic intercostal in 133 cases supplies intercostal spaces from 3 to 5 and the fourth space is more frequently supplied by this segmental artery. Only 1 of the 11 combined intercostal vessels supplies more than 1 interspace.

A third aortic intercostal artery is in bronchial combination in 2 instances (1.33 per cent of 150) 1.5 per cent of 133. In 1 case a single right bronchial is involved in the second and inferior right bronchial arises with the third aortic intercostal while the corresponding superior bronchial duplicates the relationship with the first aortic intercostal. Ruysch in his *Responsio* (1721) illustrated a common bronchial trunk arising from the right third

In 22 cadavers (14.7 per cent) one or more bronchial arteries arises from the arch of the aorta. In a single instance a left bronchial artery emerges from the anterosuperior surface of the arch immediately caudal to the roots of the innominate and left common carotid arteries and courses anterior to the trachea to reach its corresponding bronchus. In the 21 remaining cases the artery arises from some portion of the concavity of the arch cranial to the level of the first aortic intercostal vessels. In 15 (10 per cent) of these a single vessel passes to the left bronchus in 4 (2.7 per cent) a common stem provides arteries to right and left bronchi and in 2 specimens (1.3 per cent) a single right bronchial artery occurs. In only 1 case is the entire bronchial arterial supply derived solely from the aortic arch (cranial to the highest aortic intercostal) one of the 4 specimens with a common stem for both lungs arising from the concavity of the arch contributes one right and two left bronchial arteries to corresponding bronchi. In the specimen described by Boyden (1945) a single common artery arising from the inferior surface of the aortic arch bifurcated to supply both lungs.

In 3 instances (2 per cent) anomalous bronchial arteries are found to arise from a subclavian trunk. In 1 of these the aberrant vessel takes origin from the right subclavian and passes to the right superior lobar bronchus (Fig. 1 Type IX) in a second it is represented by a common stem which derived from the base of the left subclavian anteromedial to the internal mammary provides branches to right and left superior lobar bronchi in the third case a single artery arises from the left subclavian and passes to the corresponding superior lobar bronchus (Fig. 5). In each instance the arteries of subclavian origin are supplementary to one or more bronchial arteries of aortic origin. In Haller's classical case a common stem arose from the right subclavian and bifurcated to supply both lungs. In Quain's (1844) equally renowned specimen two common trunks arose from anomalous sites, from the internal mammary on the right side to provide branches to the anterior aspect of each bronchus, and from the superior intercostal on the left thereafter coursing dorsal to the subclavian artery to supply branches to the pos-

terior aspect of both bronchi. In the current series no specimen occurs in which major bronchial arteries are derived from the costovertebral trunk inferior thyroid or the internal mammary arteries although small anastomotic twigs between these vessels are frequently seen (see hereinafter).

Relation of origins to vertebral levels. Although the aortic origins of bronchial arteries range from the third to the eighth thoracic vertebral levels, nearly half of the arteries (right, 48.4 per cent left, 46.9 per cent) are related to the sixth segment and one-third (right, 34.4 per cent left, 33 per cent) to the fifth segment (see Tables IVA and IVB wherein the vertebral levels are tabulated by cases and by arteries, respectively). The remainder arise above and below the vertebral area just described with the greater degree of variation depending upon the total number of bronchial arteries in any particular specimen. The key vertebral levels in relation to the exposed mediastinal viscera are shown in Figure 6.

Considering all bronchial arteries of aortic origin as related to vertebral bodies, the following may be presented: origin opposite a single vertebral level in 57 cases (38 per cent), opposite two adjacent levels in 85 cases (56.6 per cent) opposite three adjacent levels in only 8 specimens (5.3 per cent). In 55 cases (36.7 per cent) the left bronchial arteries are opposite T5 and T6 as a unit in 26 cases (17.3 per cent) opposite T5 alone, and in 25 cases (16.7 per cent) opposite T6 alone. Thus, in 106 of 150 bodies (70.7 per cent) all left bronchial arteries of aortic origin emerge from a segment limited by the cranial margin of T5 and the caudal margin of T6.

*Whereas the width of the thoracic vertebral bodies gradually increases from above downward, there is relatively little difference in widths of bodies between T5 and T6. Variation will occur of course in relation to total body length and in the degree of spinal deformity. In determining thoracic levels in relation to sites of origins of bronchial arteries, the intervertebral discs are not considered, but included with adjacent vertebral bodies for per cent of record.

T = and the reader is the orientation of bronchial artery points of origin in reference to vertebral levels, the following vascular structures are commonly encountered opposite these topographic segments: (3) aorta; (4) T1—highest part of aortic arch, about 5 cm. caudad of jugular notch; T4—bifurcation of trachea; second part of aortic arch, beginning of thoracic aorta; T5—base of heart (cranialmost portion); T6—commencement of aorta and pulmonary artery; end of superior vena cava, distal right diaphragmatic function centrally.

The topographical relations on the right side are somewhat different, because of the association of the bronchial with intercostal arteries. In 57 cases (38 per cent) in which the bronchial arteries are not associated with intercostals the right bronchials arise opposite single vertebral levels T6 in 26 cases (17.3 per cent) T5 in 18 cases (12 per cent) T7 in 4 cases (2.7 per cent) and T4 in 3 cases (2 per cent). Right bronchial arteries unassociated with intercostals arise from the aorta at a slightly lower level than those on the left side. This circumstance is owing in part to the occurrence of the intercostobronchial trunk on the right which generally arises at the same level as the left superior bronchial artery.

On the basis of vertebral level of origin considered by arteries 260 left bronchial vessels (of an overall total of 267) arise from the descending aorta or from the aortic arch (Table IVB). Almost half of the left arteries emerge from the aorta opposite the sixth thoracic vertebral level. The range of origins extends between extremes of T3 and T8 with the majority of left bronchial arteries (80 per cent) arising opposite the combined levels of T5 and T6.

In 57 cases with right bronchial arteries arising from the aorta independent of intercostal arteries there is a total of 64 vessels the remaining 141 arteries (in 93 cases) take origin in common with intercostals or are derived from the subclavian (2 cases 2 vessels). As with the left side approximately half (31 of 64 arteries 48.4 per cent) of the independent right bronchial arteries arise from the aorta opposite T6 and 82.8 per cent opposite the combined levels of T5 and T6. The range however is more restricted than on the left side extending between T4 and T7. Thus 8 out of 10 right and left independent aortic bronchial arteries originate opposite the bodies of the fifth and sixth thoracic vertebrae.

Course. The right bronchial artery is more constant than the left in origin course and distribution. A single right artery arises from the corresponding lateral aspect of the aorta, or from its dorsolateral surface when in combination with an intercostal. In the latter type (88.67 per cent) the artery courses cranialward to insinuate itself between the azygos

vein and the vertebral bodies. At or near this site the intercostobronchial bifurcates to provide an aortic intercostal (Table II) to the appropriate intercostal space and a definitive bronchial artery which leaves the parent stem at a variable angle to course obliquely caudalward and anteriorly beneath the arch of the azygos vein on the way to the right bronchus (Fig. 4). The right bronchial artery is more frequently associated with the highest aortic intercostal when it is not it arises at too low a level to pass beneath the azygos arch. In a specimen with two right bronchial arteries each of which arises in common with an intercostal the right superior artery passes beneath the arch the inferior one does not (Fig. 3). Since the artery lies in close relationship to the trachea and esophagus it provides numerous twigs of supply to each (see hereinafter).

When a right bronchial artery arises from the aorta unassociated with an intercostal its course to the bronchus is usually more direct. From its origin on the anterolateral lateral or posterolateral aspect of the aorta the artery passes anteriorly and cranialward or anteriorly and lateralward to the right of the esophagus to reach the bronchus. Its relationship to the bronchus is similar to that of the branch derived from an intercostobronchial trunk although it is generally found in a more caudal position on the posterior surface of the bronchus.

An inferior right bronchial artery when present (33.3 per cent of cases) arises either from the corresponding lateral or anterior surface of the thoracic aorta. It may course to the right of and dorsal to or to the left of and anterior to the esophagus on its way to the right inferior lower bronchus¹⁰ (hyparterial bronchus of Aebly). Vessels of anterior origin may course superiorly to loop about the cranial aspect of the left main bronchus and then pass inferiorly inclining toward the right, on

¹⁰The nomenclature of Jackson and Heber (1941) is employed: (a) superior lobar bronchus (right upper lobar bronchus and left upper lobar bronchus (bronchus [super] of Ewart eparterial bronchus of Aebly), (b) middle lobar bronchus (right middle or cardiac bronchus of Ewart, first hyparterial ventral bronchus of Aebly), (c) inferior lobar bronchus (right and left lower lobar bronchus of Ewart, hyparterial bronchus of Aebly).

Subsequent reference to the distribution of the middle or inferior bronchial arteries to the inferior lobar bronchus refers, on the right side, to the common stem for definitive middle and inferior lobe bronchi derived from the bifurcation of the main bronchus; this is the bronchus intermedius of Ewart.

the anterior surface of the tracheal bifurcation branches are supplied to adjacent lymph nodes en route and the artery continues along the caudal border of the right main bronchus.

In 11 33 per cent of the bodies (17 of 150) one or more right bronchial arteries wind to the left and pass anterior to the esophagus in transit to the right main bronchus. In 13 of the cases the right bronchial is derived from a common stem with a left bronchial artery, and in 4 cases the right bronchial artery arises independently from the aorta. In 8 7 per cent of bodies (13 of 150) a right bronchial artery passes anterior to the trachea or tracheal bifurcation to reach the right main bronchus. In 8 of the cases the right bronchial arises in common with a left bronchial artery, and in 5 cases it has an independent aortic origin. One right bronchial artery from a common stem passes through the tracheal crotch to the anterior surface of the right bronchus resembling in its course the bronchial artery of left subclavian origin described by Schneider (1934). In other right bronchial artery of independent aortic origin passes anterior to the left main bronchus and bifurcation then turns posteriorly through the crotch to reach the dorsal aspect of the right main bronchus.

In 39 cases (26 per cent) in which one or more left bronchial arteries arise in common with a right bronchial 21 (14 per cent) possess a common stem which courses to the left dorsal to the esophagus, and bifurcates at its lateral margin (Fig. 2). The left bronchial artery then continues directly to the left main bronchus, while the right artery passes anterior to the esophagus or ascends to loop over the left bronchus and courses on the anterior aspect of the tracheal bifurcation in the manner previously described.

In the case having four right bronchial arteries (Fig. 1 Type IX) a strikingly anomalous vessel arises from the right subclavian immediately proximal to the origin of the corresponding internal mammary artery. It descends to the right of the trachea and dorsal to the superior vena cava after crossing anterior to the azygos vein it enters the pulmonary hilum along the cranial border of the superior lobar bronchus (eparterial bronchus of Aebly).

The bronchial arteries to the left lung follow a more direct and simpler course. Since most of them arise from the anterior surface of the aorta immediately behind the left main bronchus they must pass anteriorly to meet the bronchus. In one third of cases (34 7 per cent) one or more left bronchial arteries arise from the right anterolateral or lateral aspect of the aorta and pass dorsal to the esophagus to reach the left bronchus. In the single instance in which the left bronchial artery courses anterior to the esophagus it is a derivative of a common stem with a right bronchial artery. In another case a left bronchial artery emerges from the right dorsolateral aspect of the aorta at the level of the second right aortic intercostal and winds ventral to the aorta to reach the left bronchus. A left bronchial artery passes anterior to the trachea proximal to the bifurcation. In 3 cases (2 per cent) and its anterior course is restricted to that aspect of the left bronchus alone in 3 specimens (5 33 per cent). In 2 instances of the latter pattern both superior and inferior left bronchial arteries have a similar course, providing a total of 10 arteries so located (2 67 per cent of total left arteries).

Major anastomotic vessels are found connecting adjacent left bronchial arteries in 4 cases (2 67 per cent) (1) between superior and inferior bronchials (2) between superior and middle (3) between middle and inferior and (4) between the superior and second of 4 arteries. These anastomoses extend either obliquely or vertically across the posterior aspect of the main bronchus. In 3 cases (2 per cent) a major anastomosis extends transversely to connect a right and left bronchial artery, and in 1 of these the anastomotic channel courses anterior to the esophagus. Major anastomoses between inferior bronchial and primary aortic esophageal arteries are found in 47 cases (31 3 per cent) but smaller gross anastomoses between these two classes of vessels occur in every case studied.

In 8 cases (5 33 per cent) arteries to the inferior lobar bronchi arise cranial to the origins of superior lobar supply. In 5 of these the artery courses to the right lung in 1 to the left and in 2 a common stem bifurcates to supply both lungs.

The definitive bronchial artery seldom occupies the midportion of the dorsal membrane of the main bronchus although commonly it is said to do so. The superior bronchial arteries pass cranialward to reach the main bronchi on the right side at the site of bifurcation on the left side approximately 1 centimeter distal to the bifurcation corresponding to the width of the esophagus. It then tends to follow the posterosuperior margin of the cartilaginous bronchus at the site of attachment to the dorsal membrane to the superior lobar bronchus. Less frequently the entire course is along the anterior surface of the bronchus. Prominent twigs are often sent to the anterior aspect of the bronchus even when the main vessel is more dorsally placed.

The inferior bronchial arteries tend to pursue a transverse course across the pericardium in the interval caudal to the tracheal bifurcation to reach the posterosuperior or postero-inferior aspect of the inferior lobar bronchus. In their course they provide descending anastomotic rami to the esophagus and posterior mediastinal fascia. In many cases the artery follows the most dependent surface of the bronchus. Arterial rami to the anterior aspect of the inferior lobar bronchus are seen less frequently than are those of superior bronchial origin to the corresponding bronchus.

Terminally in the region of the hilum the single right bronchial artery bifurcates to supply superior and inferior lobar bronchi and their secondary subdivisions by multiple branches. In the presence of multiple arteries the superior bronchial follows the cranial border of the superior lobar bronchus while the inferior bronchial courses along the caudal or postero-inferior border of the inferior lobar bronchus. A middle bronchial when present, tends to subdivide at the main bronchial bifurcation and to send rami to both superior and inferior lobar bronchi. Immediately distal to the bifurcation of the main bronchus each arterial ramus usually assumes a more central position on the posterior membranous wall. Peribronchial arborization and anastomoses are common in the region of the hilum. Hovelacque describes a case of anastomosis between a left bronchial artery of aortic origin with the left inferior pulmonary vein.

Esophageal and other branches. Textbooks categorically describe the esophageal arterial supply as being derived in part from the bronchial arteries but little specific information concerning the overall vascular pattern for the esophagus is available.¹¹

In the present series it is constantly observed that the predominant blood supply of the middle third of the esophagus is derived from the bronchial arteries (Figs. 4, 5 and 7). Anastomoses between the bronchial and aortic esophageal branches are regularly present in 31.3 per cent of cases major anastomoses occur between inferior bronchial and esophageal arteries. Right bronchial arteries from intercostobronchial trunks always supply the dorsal aspect of the distal portion of the trachea and the adjacent segment of esophagus. Right inferior aortic arteries when present supply the esophagus liberally this would be expected from the dorsal transeophageal course of the vessel.

One or more constant large esophageal arteries arise from the anterior aspect of the thoracic aorta opposite T8 to T10. In 3 cases primary aortic esophageal arteries contribute branches of the caliber of bronchial arteries to the lower lobe of the lung (left 2 right 1) entering the parenchyma through the pulmonary ligament in its middle and inferior thirds.¹² Quain (citing Turner) described the frequent occurrence of small arteries extending laterally from the aorta to the lung between the folds of the pulmonary ligament and McCotter observed these vessels frequently. They are a prominent feature in the arterial supply of the dog's lung (Berry, Brailsford, and Daly).

In approximately 10 per cent of cadavers large pericardial arteries are derived from the bronchial arteries. These are more frequently associated with a right bronchial artery which passes superior to the left main bronchus and with right inferior bronchial arteries.

¹¹According to Cunningham (1937) its arteries consist of branches derived in the neck from the inferior thyroid, in the thorax from the bronchial arteries and thoracic aorta, and in the abdomen from the left gastric artery and from the inferior phrenic.

¹²The contents of the pulmonary ligaments were studied in only a few cases, so these data are not indicative of the true incidence of pulmonary arterial supply from primary aortic esophageal arteries. This information will be provided in an extensive study of the esophageal arterial supply currently in progress in this laboratory.

The paratracheal and bronchial lymph nodes receive an abundant supply from the bronchial arteries. Often the artery traverses a node en route to the bronchus. While in the current series no major bronchial artery is observed to arise directly from an internal mammary artery anastomoses effected by small twigs occur constantly between the superior right bronchial and the corresponding internal mammary arteries. These twigs extend either longitudinally or obliquely dorsal to the superior vena cava and lateral margin of the trachea.

Anastomosis is effected between superior bronchial arteries and the right subclavian and superior intercostal arteries, the minute rami derived from the network of vessels then supplying paratracheal and proximal bronchial lymph nodes.

Indirect anastomosis between the right bronchial of intercostobronchial derivation and the superior intercostal and subclavian is also established through the first aortic intercostal which often arises in common with the definitive bronchial artery.

The potential anastomotic relationship between bronchial and associated mediastinal arteries and the coronary arteries was described by Hudson, Moritz, Wearn (1932). By injection technique these authors demonstrated widespread anastomoses of auricular branches and the coronary branches to the pericardial fat with pericardicophrenic branches of the internal mammary arteries and with the anterior mediastinal pericardial, bronchial superior and inferior phrenics in intercostal and esophageal branches of the aorta. Gross anastomoses between the intercostal internal mammary esophageal and bronchial arteries were also demonstrated in the dog as lung by Berry, Brailsford, and Daly and by Horine and Warner (1932).

The vagus and associated pulmonary nerves receive minute rami from the bronchial arteries (Fig 7) as well as from adjacent intercostal, esophageal and mediastinal vessels.

Situs inversus viscerum. One cadaver (not included in the tabulations) reveals a complete situs inversus viscerum. Its bronchial artery pattern with one left and two right vessels is the mirror image of Type I. The left

artery arises in common with a first left intercostal and the right inferior bronchial from the lateral aspect of the aorta. Neither of these arrangements occurs per se in the regular series. The levels of origin are slightly lower than those usually seen, the right arteries being found opposite T6 and T7. The left intercostobronchial artery provides an intercostal branch to supply the first, second and third intercostal spaces.

CONCLUSIONS AND SUMMARY

The origin, course and distribution of the bronchial arteries are described for a series of 150 cadavers. The specimens are catalogued on the basis of types (I to IX) in the order of decreasing frequency of occurrence, and subdivided on the bases of arterial origin. Type I, two left and one right arteries, in 40.67 per cent. Type II, one left and one right, in 21.33 per cent. and Type III, two arteries to each side in 20.67 per cent. comprise 82.67 per cent of all patterns. Variations in number including 4 arteries to a side (2 cases) and a total of 5 bronchial arteries (6 cases) are observed.

The aortic sites of origin of right bronchial arteries differ markedly from those of the left side not only in position but in relation to parietal vessels. These bronchial vessels arise on the right anterolateral, lateral, or posterolateral surface of the aorta and in 83.7 per cent of cases in common with an aortic intercostal artery. The right 1st aortic intercostal participates in the common intercostobronchial stem in 78 per cent, the 2nd aortic intercostal in 7.33 per cent, and the 3rd aortic intercostal in 1.33 per cent. Left bronchial arteries arise from the anterior surface of the aorta or from the arch less commonly they emerge from the right lateral or posterolateral aspect and only rarely from the left surface. In only 6 cases (4 per cent) does a left bronchial arise in common with an intercostal artery, the latter vessel is invariably a right intercostal. Except in the rare case of situs inversus viscerum bronchial arteries of either side have no relationship with left intercostal vessels.

In 74 per cent of cadavers bronchial arteries arise independently of each other in

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THE USE OF SULFADIAZINE AS A PREOPERATIVE AND POSTOPERATIVE MEASURE IN HYPERTHYROIDISM

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THE management of the patient with thyroid disease in a large municipal hospital presents certain problems because of the size of the wards and the consequent lack of privacy and quiet. This condition constitutes a very vital hazard to the patient with hyperthyroidism to whom stimuli of almost any kind are particularly upsetting. Since 1929 the medical and surgical services of the Third (New York University) Division Bellevue Hospital have collaborated in the care of these patients; one member of each staff being primarily responsible in co-operation with the resident physicians of each service for the handling of the patient. Therapy consisted of a high caloric diet during the preoperative period and Lugol's solution 20 to 30 drops daily. This treatment was continued until the patient showed a decrease in the degree of hyperthyroidism as evidenced by gain in weight fall in the basal metabolic rate and slowing of the heart rate. From 1909 to 1941 thyroidectomies were performed on a total of 432 patients. Twenty patients died postoperatively either in thyroid crisis within 48 hours after operation or as a result of infection associated with thyroid crises. Analyses of the deaths showed that (1) in several of the patients there had been a tendency to some elevation of temperature in the preoperative period (2) immediately after operation there was a sharp rise in temperature and heart rate (3) signs of pneumonia usually developed if the patient survived for more than 24 hours and (4) on postmortem examination there was evidence of lobular or lobar pneumonia. Infection has often been reported as a factor in precipitating thyroid crises (2) and the findings in our patients seemed to support this observation. Therefore in September 1941 as a measure intended to prevent infection sulfonamide therapy was instituted following operation whenever the temperature rose to 101 degrees. In the first cases sulfathiazole was given but sulfadiazine soon became available and has been used since. Sulfonamide therapy was so satisfactory in controlling the temperature and any associated infection that it was decided to give the drug before operation in an effort to prevent postoperative infection. Each patient received 8 grams of sulfadiazine by mouth in divided doses in the 24 hour period before operation. The sulfadiazine was continued after operation 4 grams daily for to 4 days. The administration of sulfadiazine has constituted the only significant change in the management of patients since the fall of 1941. This method of therapy was begun about the time that Mackenzie and associates (November 1941) (6) published their original report on the effect of sulfaguanidine on the thyroid glands in rats. In 1942 and again in 1943 the Mackenzies (4, 5) and Astwood demonstrated the goiterogenic activity of additional sulfonamides and of thiourea. It seemed possible on the basis of their reports that by the use of sulfadiazine dual effects were being obtained: i.e. antithyroid and anti-infective which perhaps accounted for the results.

RESULTS

This method of therapy has now been used on a total of 75 patients of whom 54 had severe hyperthyroidism (Table I). In several patients the operation was done in 2 stages because of the degree of thyrotoxicosis so that a total of 85 operations were done. Since its use no deaths have occurred. It may be argued that the number of cases is not large but in a similar number of patients (Table II) operated on before this regimen there were 4 deaths and many of the patients had a stormy post-

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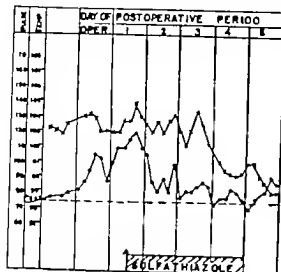


Chart Case 493. 24 year old female Basal metabolic rate prior to administration of Lugol's solution +70 per cent prior to operation and after 78 days of Lugol's solution +30 per cent. One lobe of the thyroid gland was removed at the first operation. On the first day following operation the temperature rose 1 degree and the pulse continued to be rapid. The patient became restless and very difficult to quiet. 5 gr thiazole 30 cc by mouth. The temperature rose 1 degree the pulse 40 per minute and then both pulse and temperature began to fall. The pulse rate remained low for several days and then fell to normal limits. The drug was discontinued after the 4th postoperative day.

operative course Sulfadiazine has also been used in the treatment of thyroid crises occurring before operation and has controlled the condition rapidly as is illustrated in Case 490. The advantages of sulfadiazine are that it has relatively little toxicity that it can be given intravenously and that the effect in the patient in thyroid crisis is rapid.

Effect of sulfonamide therapy in the postoperative course and in thyroid crises The course in 6 patients has been charted to illustrate the effects of sulfonamide therapy. In 3 patients (Cases 483, 497 and 516 Charts 1 to 3) the drug was only given postoperatively when the temperature and heart rate had begun to rise. Case 483 (Chart 1) was a 24 year old female with severe hyperthyroidism. Her response to Lugol's solution had not been satisfactory and during the 78 days of preoperative care in the hospital, the basal metabolic rate had varied from +75 to +54 per cent. No sulfonamide was given preoperatively. Following the first operation at which one lobe of the thyroid was removed the temperature rose to

TABLE I—SUMMARY OF 85 OPERATIONS ON 15 PATIENTS TREATED WITH SULFADIAZINE

Number of females	8
Number of males	7
Age range in years	20 to 32
Number of patients with hyperthyroidism	8
Average B.M.R. of the hyperthyroid patients	
After Lugol's solution and before operation	+58 per cent
Range of B.M.R. after Lugol's	+31 to +60 per cent

TABLE II—SUMMARY OF 81 OPERATIONS ON 15 PATIENTS TREATED PRIOR TO USE OF SULFADIAZINE THERAPY

Number of females	6
Number of males	14
Age range	22 to 30 years
Average B.M.R. of preoperative hyperthyroid patients	
After Lugol's solution and before operation	+50 per cent
Range of B.M.R. after Lugol's	+34 to +60 per cent

Deaths in This Group

Case number	474	392	477	478
Age	33	34	46	35
Sex	F	F	F	F
Preoperative B.M.R.	+32	+12	+44	+19
Day of death after operation	1st	7th	8th	1st

Second stage operation.

103 degrees, the pulse rate to 140 per minute, and the restlessness characteristic of thyroid crises was manifested. Fluids were given intravenously and in addition sulfadiazine was administered. The temperature and pulse declined the patient became quieter and within 12 hours intravenous administration of fluids was discontinued. The severe degree of hyperthyroidism was reflected in the microscopic section of the lobe removed at the first operation which showed acini of varied size which only in certain areas contained poorly staining colloid. The epithelium appeared heaped up with buds in the acini. In areas the epithelial hyperplasia was so great that no definite acinar structure was seen.

CASE 497 (Chart 2) was a 33 year old male. Preoperatively no sulfadiazine was given. The basal metabolic rate 2 days before operation was +38 per cent. The temperature began to rise during the evening of the day of operation. Sulfadiazine was begun (2.5 grams intravenously) and was continued for 3½ days. The temperature was readily controlled and the patient made an uneventful recovery.

CASE 516 (Chart 3) a 26 year old female, had had a complicated preoperative course due to a respiratory infection and an ulcer of the cornea. The preoperative period was prolonged and with administration of Lugol's solution the basal metabolic rate had only decreased from +52 to +42 per cent. No sulfadiazine was given preoperatively. On the day fol-

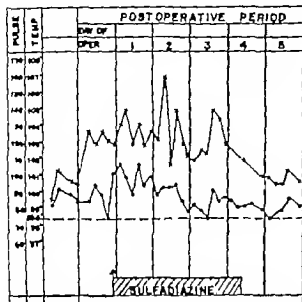


Chart 2. Case 497, a 33 year old male. The patient had had a previous admissions and had refused operation. He was carried on Lugol's solution for 5 months. His basal metabolic rate just prior to operation was +43 per cent. At this first operation the right lobe of the thyroid was removed. The pulse rate rose during the operation and when the temperature rose to 101 degrees on the night of operation sulfadiazine was begun. The first dose was given intravenously along with an infusion. The pulse rate remained elevated for several days but the temperature was controlled by the 2nd day and the patient made an uneventful recovery.

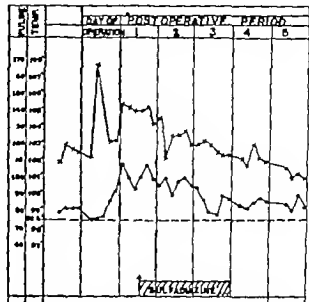


Chart 3. Case 516, a 26 year old female. Basal metabolic rate prior to administration of Lugol's solution +52 per cent prior to operation +42 per cent. The preoperative course was prolonged due to a respiratory infection which was followed by corneal ulcers. No sulfadiazine was given preoperatively. On the first postoperative day the temperature rose to 101.8 degrees, the pulse to 140, and the patient became restless and apprehensive. Sulfadiazine was begun and by the 3rd postoperative day both the temperature and pulse were controlled.

Following operation the temperature rose to 101.8 degrees and the heart rate was 140 per minute. Sulfadiazine was begun on the afternoon of that day and as is shown in the chart both the heart rate and the temperature began to drop and the drug was discontinued on the third day as the patient was objectively and subjectively greatly improved.

Cases 498, 524 and 547 (Charts 4 to 6) received sulfadiazine in the 24 hours before operation and it was continued after operation as is indicated. Case 498 (Chart 4) was a 21 year old female whose basal metabolic rate had fallen from +32 to +10 per cent. The postoperative course was exceptionally smooth the temperature rising on only 1 occasion to 101.4 degrees. Case 524 was a 39 year old colored female with diabetes mellitus as well as hyperthyroidism. The patient had been receiving Lugol's solution as an out patient for 5 months. When she consented to operation she was hospitalized and before operation the basal metabolic rate was +13 per cent. There was a rise in temperature to 102 degrees on the first day after operation but this fell on the same day to 100.8 degrees and the course from then on was uneventful. Case 547 (Chart 6) was a 37 year old colored female. This patient was apprehensive, nervous, and restless during the preoperative period. With administration of Lugol's solution the basal metabolic rate fell from +57 to +35 per cent. The heart rate was elevated daily ranging from 98 to 130

per minute. Sulfadiazine was given preoperatively and although the patient continued to have a rapid heart rate for the first 5 days after operation and the temperature rose on the 1st and 2nd day to 102.4 degrees, her postoperative course was well controlled.

The effect of sulfadiazine in a patient who developed thyroid crisis on 3 occasions is demonstrated in Chart 7. This was Case 490, a 46 year old colored male patient whose entire course was unstable and whose hyperthyroidism was complicated by congestive heart failure. The operation was done in 2 stages. At the first operation the right lobe of the thyroid was removed. Postoperatively the temperature rose to 104.2 degrees, the pulse to 170 per minute. Sulfadiazine was given intravenously then by mouth and continued for 9 days. Within 24 hours the pulse rate had decreased to 136 per minute and the temperature to 101.4 degrees. The patient was readmitted 5 months later for the second stage operation. During the period of preparation for thyroidectomy the patient appeared to be developing thyroid crisis the temperature rising to 104.4 degrees and the pulse rate to 168 per minute. He received sulfadiazine and sodium iodide intravenously with a prompt remission of the symptoms. He was operated on 16 days later and through error no sulfadiazine was given preoperatively. On the day after operation the temperature rose to 105.6 degrees. Sulfadiazine was then given intravenously and both temperature and pulse rate fell rapidly the remainder of the postoperative course was uncomplicated.

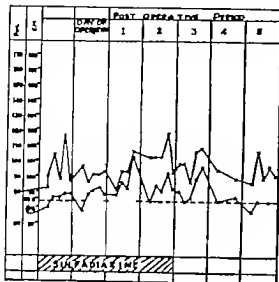


Chart 4. Case 408, 37 year old female. Basal metabolic rat prior to administration of Lugol's solution +38 per cent, after its administration +80 per cent. Preoperative period was 4 weeks. Sulfadiazine was given during the 24 hours prior to operation and was continued for 4 days following operation. The postoperative course was uncomplicated and the patient was discharged from the hospital on the 8th postoperative day.

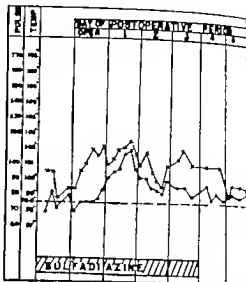


Chart 5. Case 544, a 30 year old colored female with severe diabetes mellitus. Prior to the administration of Lugol's solution the basal metabolic rat was +45 per cent. She was treated with Lugol's solution in the clinic for 4 months and was then sent into the hospital for operation. The basal metabolic rat prior to operation was +38 per cent. Sulfadiazine was given in the 24 hours before operation and was continued until the 4th postoperative day. The temperature rose on the afternoon of the 1st postoperative day but aside from this the postoperative course was uneventful.

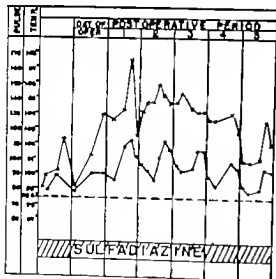


Chart 6. Case 547, 37 year old colored female. This patient was nervous and apprehensive and no satisfactory basal test could be done prior to the administration of Lugol's solution. After Lugol's solution had been given for 60 days the basal metabolic rat was +45 per cent. Sulfadiazine was given in the 24 hours prior to operation and right hemithyroidectomy was done. The pulse rate remained elevated for 4 days and the temperature rose on the 1st and 2nd postoperative days to 103 degrees. The patient, however, was quiet and showed no signs of thyroid crises.

As a comparison the characteristic reaction of uncontrolled thyroid crises occurring postoperatively is illustrated in Chart 8. These 3 patients received the therapeutic measures employed prior to the discovery of antithyroid drugs, i.e. infusions, sodium iodide sedation, and iced enemas to reduce the temperature with no effect—both patients died. This severe type of reaction accompanied by a rapid rise in temperature and pulse rate has been controlled in the patients receiving sulfadiazine before and after operation.

Microscopic appearance of the glands. Microscopic sections of all glands removed at operation were examined. We are indebted to Doctor John Hall of the Department of Pathology for his opinion and diagnosis of the sections. Unfortunately on the basis of the microscopic appearance of the glands it was not possible to evaluate the goiterogenic effect of the sulfadiazine administered in the 24 hours before operation. This is not surprising as in patients with severe hyperthyroidism the involution resulting from administration of Lugol's solution is irregular and areas of com-

siderable hyperplasia are usually present. The general impression of the microscopic sections of the glands of the patients in this series was that they were still hyperplastic but that there was also evidence of the involution associated with iodine administration. The acini varied in size, some containing light and others dark or pink staining colloid. The epithelium lining the acini varied from plump cuboidal cells to layers of columnar cells in the larger acini. Many acini contained papillary epithelial processes which extended into the lumen. Some few collections of lymphocytes were scattered throughout the interstitial tissue. In Figure 1 are shown microscopic sections of the thyroid glands removed from Cases 524 and 497 (second operation). Both patients received 8 grams of sulfadiazine in the 24 hours prior to operation. In Figure 2 are microscopic sections from Cases 483 and 497 (first stage operation). Neither of the patients received sulfadiazine preoperatively. All of the sections show hyperplasia of the thyroid tissue with areas of colloid deposition. It is obviously difficult to judge to what extent the hyperplasia might have been influenced by the preoperative administration of sulfadiazine. Even in Case 497 in which the patient received sulfadiazine before the second stage thyroidectomy (Fig. 1) but received none before the first stage it would be difficult to evaluate the antithyroid effect of the drug.

The state of the thyroid gland at operation in the patients receiving sulfadiazine preoperatively provided no unusual technical difficulties. Bleeding was not a complication nor was the gland friable or easily torn.

DISCUSSION

Hyperemia and enlargement of the thyroid gland have been shown to follow the administration of the sulfonamides as well as of thiouracil (4, 5, 6). The Mackenzies (5, 6) reported that sulfaguanidine, sulfadiazine and sulfapyridine were effective in this respect. They noted that the administration of iodine conferred no protective action on the thyroids of animals fed sulfaguanidine. In fact the condition of the thyroid gland both as to enlargement and histologic changes seemed to be aggravated by the administration of

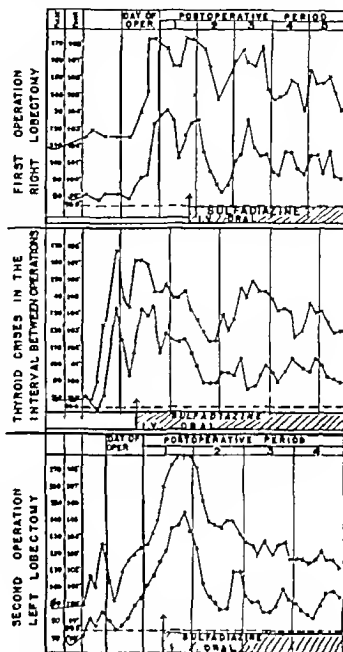


Chart 7. Case 490, a 46 year old colored male was admitted in congestive heart failure complicating hyperthyroidism. The basal metabolic rate prior to operation after 50 days of administration of Lugol's solution was +25 per cent. A right lobectomy was done at 11. First operation. The temperature and pulse rose and the patient developed the characteristic signs of thyroid crisis. Sulfadiazine was begun intravenously and continued orally. The signs of crisis abated and the patient improved. The basal metabolic rate at the time of discharge 17 days after operation was +5 per cent. The patient returned for the second stage operation 3½ months later. He developed thyroid crises during the preoperative period and this was controlled by the administration of sulfadiazine. Due to an error he received no sulfadiazine preoperatively and on the first postoperative day he again developed the signs of crisis and again he responded to the administration of sulfadiazine. The patient received either Lugol's solution or a cumulative dose of iodine during the entire time.

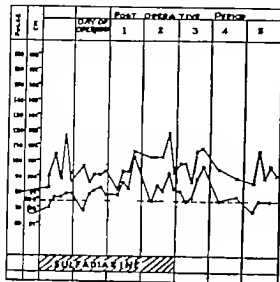


Chart 4. Case 498. 37 year old female. Basal metabolic rate prior to administration of Lugol's solution +3 per cent, after its administration +20 per cent. Preoperative period was 7 weeks. Sulfadiazine was given during the 24 hours prior to operation and was continued for 5 days following operation. The postoperative course was uncomplicated and the patient was discharged from the hospital on the 8th postoperative day.

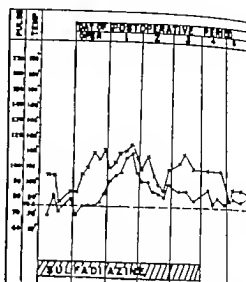


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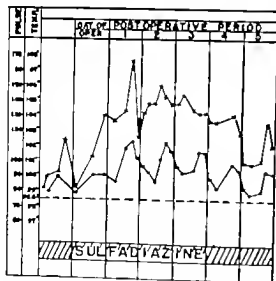


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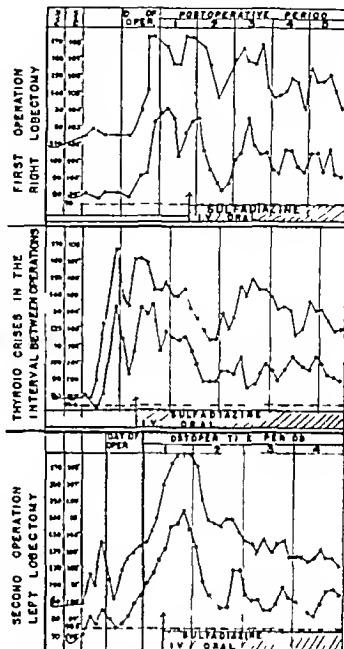


Chart 7. Case 490, a 41-year-old female, male, admitted in congestive heart failure complicating hyperthyroidism. The basal metabolic rate preoperatively after 30 days of administration of Lugol's solution was +25 per cent. A right lobectomy was done at the first operation. The temperature and pulse rose and the patient developed the characteristic signs of thyroid crisis. The crisis was begun intravenously and continued orally. The signs of crisis abated and the patient improved. The basal metabolic rate at the time of discharge 17 days after operation was +5 per cent. The patient returned for the second operation 245 months later. A left lobectomy was done during the preoperative period and this was controlled by the administration of sulfadiazine. Due to an error, the patient received no sulfadiazine preoperatively and on the first operative day he again developed the signs of thyroid crisis. The patient responded to the administration of sulfadiazine. The patient received either Lugol's solution or Lugol's Iodine during the entire time.

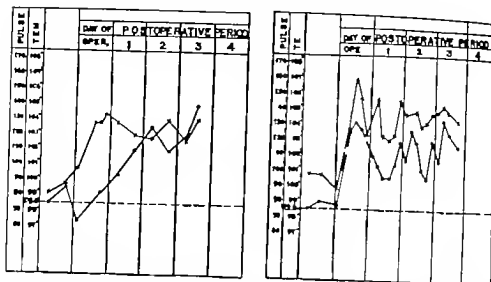


Chart 8 Course in 2 patients who developed thyroid crises following operation and died prior to institution of sulfadiazine therapy. Left, Case 64, a 51 year old female. Basal metabolic rate prior to administration of Lugol's solution +37 per cent, after Lugol's and prior to operation +3 per cent. The pulse rate increased during the operation and remained elevated. The temperature rose on the first postoperative day and the patient became restless and apprehensive. The treatment consisted of transfusion, infusions, sedation and administration of Lugol's solution. She died on the 3rd postoperative day.

Right Case 397. 48 year old female. This was the second stage of the thyroidectomy. Basal metabolic rate on admission was +6 per cent, after preoperative preparation +51 per cent. The patient had been on Lugol's since the first operation. As the patient's heart rate was within normal limits and the temperature was never above 98.6 degrees, and this as the second stage operation, it was considered safe to proceed. Both the pulse and temperature rose precipitously following operation. The temperature fell on the first postoperative day but rose again. The pulse rate remained very rapid and the patient developed the restlessness and apprehension characteristic of thyroid crisis. She died on the 3rd postoperative day.

The uncontrolled reaction in these cases should be compared to the courses in Cases 483, 497 and 490, in which sulfadiazine was given when the temperature and pulse rate rose following operation.

iodine. Astwood in assaying the various sulfonamides in respect to their goiterogenic activity found that sulfadiazine was the most effective. Administration of the sulfonamides to rats was accompanied by hyperplasia of the thyroid and a lowering of the basal metabolic rate.

The exact mechanism by which the sulfonamides and the thioureas exert their goiterogenic effect has been the subject of some discussion. In a recent report Mackenzie (3) postulates that the action of the sulfonamides differs from that of the thioureas and that this difference is illustrated when sodium iodide is given in conjunction with thiouracil or sulfaguanidine. He observed that the response to thiouracil was affected in two ways by the addition of sodium iodide to the diet of the rat. Small amounts of iodide inhibited the thyroid enlargement produced by thiouracil but had

no effect on the hyperplasia. Larger amounts of iodide suppressed the hyperplastic change that usually accompanies the enlargement of the gland. However when sulfaguanidine and sodium iodide were given together "iodide neither reduced the size of the thyroid nor inhibited the degree of hyperplasia. On the contrary a high level of iodide actually potentiated the goiterogenic action of low levels of sulfaguanidine and increased the weight of the gland by 30 to 40 per cent. These observations are of particular interest to us as we administered either Lugol's solution or sodium iodide along with the sulfadiazine to the patients and found that this method of therapy reduced the incidence of severe postoperative reactions and controlled thyroid crises when it

According to the U.S.P. formula for Lugol's solution, it contains 2.6 per cent iodine, 5 per cent of which is free or elemental iodine and 7.6 per cent of which is present as iodide.



Fig. 1. Microscopic sections from the thyroid glands of Cases 524 and 497 (second operation). Both of the patients received 8 grams of sulfadiazine in the 24 hour period prior to operation. Left, Case 524 had been receiving Lugol's solution for 5 months prior to operation. The basal metabolic rate before operation was $+13$ per cent. There is pronounced hyperplasia of the gland and also evidence of some involution with colloid deposition. Right in Case 497 this is the section of the thyroid gland removed at the 2nd stage

of a 2 stage thyroidectomy. The patient received sulfadiazine prior to this operation. He had been receiving Lugol's solution since before the first operation a total period of 210 days. This section shows colloid deposition and also areas of remaining hyperplasia. The microscopic section from the gland removed at the first operation at which time no sulfadiazine was given, is shown in Figure 2. There does not seem to be any significant difference in the degree of hyperplasia or colloid deposition shown in these sections.



Fig. 2. Microscopic sections from the thyroid glands of Cases 483 and 497 (first stage operation). These patients did not receive sulfadiazine preoperatively. The sections show hyperplasia and areas of involution with colloid deposition. The basal metabolic rate in Case 483 left, prior to operation was $+34$ per cent, and in Case 497 right, it

was $+38$ per cent. The course in these 2 patients is shown in Charts 1 and 2. The microscopic section in Case 497 should be compared to the microscopic section from the gland of this same patient shown in Figure 1 as the latter was removed at the second operation prior to which the patient received sulfadiazine.

occurred either before or after operation. The question of a goiterogenic effect in the patients was impossible to evaluate satisfactorily on the basis of the microscopic appearance of the

gland. When the sulfadiazine was given before operation it was only for a period of 24 hours and it might well be questioned whether this period of time was sufficiently long to per

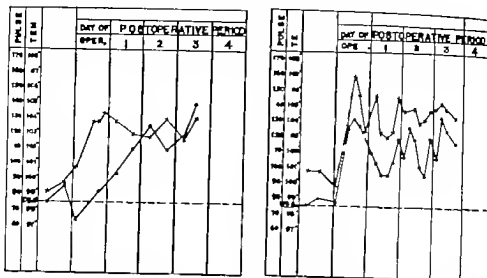


Chart 8 Course in patients who developed thyroid crises following operation and died prior to the institution of sulfadiazine therapy. Left, Case 164, 51 year old female. Basal metabolic rate prior to administration of Lugol's solution + 7 per cent, after Lugol's operation + 3 per cent. The pulse rate increased during the operation and remained elevated. The temperature rose on the first postoperative day and the patient became restless and apprehensive. The treatment consisted of transfusion, infusions, sedation and administration of Lugol's solution. She died on the 3rd postoperative day.

Right, Case 197, 48 year old female. This was the second stage of the thyroidectomy. Basal metabolic rate on admission was +6 per cent, after preoperative preparation +33 per cent. The patient had been on Lugol's since the first operation. As the patient's heart rate was within normal limits and the temperature was never above 38.6 degrees, and this was the second stage operation it was considered safe to proceed. Both the pulse and temperature rose precipitously following operation. The temperature fell on the first postoperative day but rose again. The pulse rate remained very rapid and the patient developed the restlessness and apprehension characteristic of thyroid crises. She died on the 3rd postoperative day.

The uncontrolled reaction in these cases should be compared to the courses in Cases 483, 497 and 499 in which sulfadiazine was given when the temperature and pulse rate rose following operation.

iodine. Astwood in assaying the various sulfonamides in respect to their goiterogenic activity found that sulfadiazine was the most effective. Administration of the sulfonamides to rats was accompanied by hyperplasia of the thyroid and a lowering of the basal metabolic rate.

The exact mechanism by which the sulfonamides and the thioureas exert their goiterogenic effect has been the subject of some discussion. In a recent report Mackenzie (3) postulates that the action of the sulfonamides differs from that of the thioureas and that this difference is illustrated when sodium iodide is given in conjunction with thiouracil or sulfaguanidine. He observed that the response to thiouracil was affected in two ways by the addition of sodium iodide to the diet of the rat. Small amounts of iodide inhibited the thyroid enlargement produced by thiouracil but had

no effect on the hyperplasia. Larger amounts of iodide suppressed the hyperplastic change that usually accompanies the enlargement of the gland. However when sulfaguanidine and sodium iodide were given together "iodide neither reduced the size of the thyroid nor inhibited the degree of hyperplasia. On the contrary a high level of iodide actually potentiated the goiterogenic action of low levels of sulfaguanidine and increased the weight of the gland by 30 to 40 per cent. These observations are of particular interest to us as we administered either Lugol's solution or sodium iodide along with the sulfadiazine to the patients and found that this method of therapy reduced the incidence of severe postoperative reactions and controlled thyroid crises when it

*According to the U.S.P. formula for Lugol's solution, it contains 1.6 per cent iodine, 5 per cent of which is free or elemental iodine and 7.6 per cent of which is present as iodide.

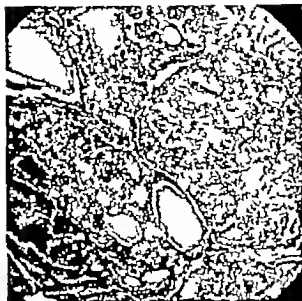


Fig. 1. Microscopic sections from the thyroid glands of Cases 524 and 497 (second operation). Both of the patients received 8 grams of sulfadiazine in the 24 hour period prior to operation. Left, Case 524 had been receiving Lugol's solution for 5 months prior to operation. The basal metabolic rate before operation was +13 per cent. There is pronounced hyperplasia of the gland and also evidence of some involution with colloid deposition. Right, in Case 497 this is the section of the thyroid gland removed at the 2nd stage

of a 2 stage thyroidectomy. The patient received sulfadiazine prior to this operation. He had been receiving Lugol's solution since before the first operation a total period of 210 days. This section shows colloid deposition and also areas of remaining hyperplasia. The microscopic section from the gland removed at the first operation, at which time no sulfadiazine was given, is shown in Figure 2. There does not seem to be any significant difference in the degree of hyperplasia or colloid deposition shown in these sections.

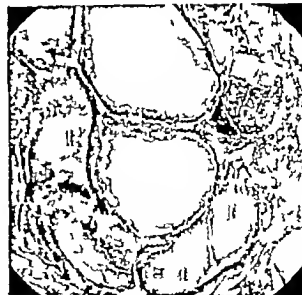


Fig. 2. Microscopic sections from the thyroid glands of Cases 483 and 497 (first stage operation). These patients did not receive sulfadiazine preoperatively. The sections show hyperplasia and areas of involution with colloid deposition. The basal metabolic rate in Case 483, left, prior to operation was +34 per cent, and in Case 497, right, it

was +38 per cent. The course in these 2 patients is shown in Charts 1 and 2. The microscopic section in Case 497 should be compared to the microscopic section from the gland of this same patient shown in Figure 1 as the latter was removed at the second operation prior to which the patient received sulfadiazine.

occurred either before or after operation. The question of a goiterogenic effect in the patients was impossible to evaluate satisfactorily on the basis of the microscopic appearance of the

gland. When the sulfadiazine was given before operation it was only for a period of 24 hours and it might well be questioned whether this period of time was sufficiently long to per-

TABLE III—SULFADIAZINE TREATED GROUP

Case No.	Age years	Sex	Blood factors Leucon per cent	Metabolism prior to operation and after Leucon per cent	Duration of Leucon preop days	Postoperative		Complications
						B M R per cent	days in hospital	
476	5	F	+7	+42	26	+43		Tracheal collapse postop Tracheostomy
red op			+24	+64	28	+ 6		
78	18	F	—	—		— 9		
50	18	F	—	—	None	—	6	
28	26	M	+	+	6	—		
28	24	F	—	—	None	—	7	
28		F	+76	+30	78	+20	8	Thyroid crisis postop.
red op				+24 to +22	1 1/2 days 23	+ 2	7	
484	20	F	+24	+		+	8	Thyroidectomy left lobe 34 years before
280	36	F	+6	+30	25	+		
487	36	F	+24	+ 8		— 4		Diabetes mellitus
58	26	M	+ 7			+ 8	5	
279		F		+ 16	In clinic 240	— 7	7	
490		M	+26	+26	30	+ 5	8	Admitted in congestive heart failure Bronchopneumonia postop
red op				+20 to +24	1 1/2 days 05	— 2	20	Thyroid crisis twice preop. Treated with insulin
20	36	M	+	+26	In clinic 30	+		
28		F	+64	+ 7	25	+		
494	44	F	+5	+	9	— 8	9	Throat culture positive for bacillus dysenteriae
206		M		+ 10 + 8	In clinic 30	+ 5	9	
497		M		+4 to +	In clinic 30	+ 8		
red op				+60 to +20	1 1/2 clinic and hosp	+ 4	9	
498		F	+	+20	26	— 2	8	
499	26	F	Unable to test				8	
500	30	F	—		5	— 5	9	
501	46	F	—			+	8	
502		M	+	+22		+22		Paroxysmal muscular fibrillation
30	27	M		+	Carried in clinic for years	+ 8	2	
21	7	F		+22			20	Cerebral occlusion postop pt had diabetes
503	3	F	+18	+ 9	5	+		
505	40	F	+26	+26	24	+ 5	8	
507		F	+18	+		+ 7		
508	20	M	+2	+		+ 7		
509		F	+40	+28	2	+		1st stage done 28 min. before hosp.
3		M	+ 7	+	In clinic 20	+ 8	18	2nd stage

TABLE III.—SULFADIAZINE TREATED GROUP—Continued

Case No.	Age years	Sex	Basal before Lugol per cent	Metabolism prior to op- eration and after Lugol per cent	Duration of Lugol prep days	Postoperath		Complication
						B.M.R. per cent	day in hospital	
2nd op				+20 t + 0	1 wk and hosp 20	+		
3	57	F	+4	+ 7	3	+ 3	21	Kept in hosp. because of home situation
33	4	F	+13	+	7			
3		F		+20	3		8	
34	3	F		- 3	1 wk 5	-	0	
35	58	F		+20 to + 8	1 wk 30	-	4	
36	16	F		+5 t +4	1 wk 60	+ 0	4	Thrombophlebitis and cornea lacerations operatively
37	4	F	+14	+17		+ 8		
38	48	F		+ 4	In clinic 3	- 3	4	
39	48	M	+ 00	+18	7	+ 0	0	
310		F	+ 3	-	8	-	4	Post op. tetany treated with calcium
3	44	F	+14	+30	9	+ 0		
31	46	M	+3	+	3	+ 8	5	Thyroidectomy (another hosp) 3 yrs prior
33	30	F		+ 11 + 3	In clinic 3	+ 0	4	Diabetes mellitus
34		F	-	- 8	None	- 3	8	
316	33	F	-		None	- 8	8	
37	4	F	- 8		None	- 9	8	
330	60	M		+17 t +20	1 wk 75	+ 7	0	
2nd op				+ 6	1 wk and hosp 5	+ 6		
33	47	F	+47	+ 7	3	-	0	
333	35	F	+17	+	3	-		
31	8	F		+20	At later rule by L.M.D. for 60	-	0	
313	34	M	+16	+ 6	60	- 3	70	Thiomycin tried. pt. became toxic. pt. has had diabetes mellitus
316	30	F	+	- 3	None		7	
337	43	F	-		3	- 4	3	Postop. tetany
313	55	F	- 7		None	- 9	3	
316	47	F	+	+ 7	30	- 7	8	
34	60	F	+		None	-	3	
3	3	F	+ 7	+	3		6	
3	33	F		- 4	0	-	4	
33	46	F	+20	+ 4	1 wk 30	- 3	6	
344	30	F	- 3		None	-		Pt. transferred to psych. postop.
343	9	F	+	+ 6		+ 8	3	Recurrent hyperthyroidism. Pt. had stage thyroidectomy in 1930

TABLE III.—SULFADIAZINE TREATED GROUP—Concluded

Case No.	Age years	Sex	Radioactive iodine before Logol per cent	Metabolism prior to operation and after Logol per cent	Duration of Logol prior days	Postoperatively		Complications
						BMR per cent	day 1 hospital	
146		F	+	+58	95	+7	0	Thyroid given for short period. It became unabsorbed. Pt. had severe psychoneurosis requiring prolonged preoperative therapy.
144	5	F	Impossible to do	+5	60		Remained in hospital for 2nd stage	
2nd p.				+25	20	-3	7	
148		F	+6	+4	90	-2		Severe psychosis and malnutrition
140		M	+92	+	27		Remained in hospital for 2nd stage	
2nd op.					0	+		
390	48	F	+5	+20	44	+	14	
	20	F	+5	+	In clinic 20			
52		F	+3		5			
113	44	F	+6	+	In clinic 20	+2		Acute proctitis postoperatively
54		F	Unsatisfactory					
2nd op.					Radioactive iodine		45	Carcinoma of the thyroid
	6	M		+	In clinic 55			
157	20	F	-2	+	5		7	
59		F	+6	-				
360		F	+26	+20	28	+4	2	Original operation 37 years before in Paris. Recurrent hyperthyroidism
58	1	M	+1	+5	21			
								Diabetes mellitus

mit a goiterogenic effect. In this regard the observations of Astwood and associates may be of interest. They reported that in rats histological changes are visible in the thyroid gland 48 hours after the administration of the sulfonamides or the thioureas. The minimal effective dose of sulfadiazine reported for rats was 4.2 milligrams per 100 grams of body weight. With larger doses the effect was visible earlier. The body weight of the hyperthyroid patients in our group did not exceed 70 kilograms and on this basis the dose of sulfadiazine given before operation was about 8.8 milligrams per 100 grams of body weight. The possibility does, therefore, exist that the sulfadiazine might have exerted some goiterogenic effect which the already hyperplastic state of the gland masked. This point deserves further investigation. Another interesting fact was that sulfadiazine was effective in control

ling the rise of temperature and heart rate and the other signs of thyroid crisis if they occurred after complete removal of the gland. This is illustrated in Case 490 in whom thyroid crisis occurred after the second stage of the operation when removal of all remaining thyroid tissue was done. One of the enigmas of thyroid crises has been that it can occur after subtotal thyroidectomy when the amount of thyroid tissue remaining in the patient is small. This is again illustrated in Case 297 (Chart 8) a patient operated on before sulfadiazine was used who developed thyroid crises after the second stage operation and died. Also in a recent report by McArthur Rawson Means, and Cope of 25 patients developing thyroid crises after operation 13 had had subtotal thyroidectomies. The fact that thyroid crises can occur after as well as before removal of the thyroid gland suggests that this reaction may

not originate primarily in the thyroid. The abnormal stimulus which precipitates the storm may well arise elsewhere in the body and may reflect a severe disturbance in hormonal balance. From our experience with these patients sulfadiazine has what might be considered a hitherto undescribed effect on thyroid crises. It does not seem plausible to invoke the anti-infective or goiterogenic actions of the drug to explain this phenomenon. Thus the use of sulfadiazine may constitute another of the empiric procedures to be added to those already used in the management of the patient with hyperthyroidism. One must acknowledge that most of the procedures utilized in the treatment of this disease including thyroidectomy are empiric.

SUMMARY

Eighty-five thyroidectomies were done on 75 patients with thyroid disease. 54 of the patients had severe hyperthyroidism. In addition to the usual preoperative therapy with Lugol's solution most of the patients received 8 grams of sulfadiazine in the 24 hours before operation. The postoperative course in these patients was not attended by any severe reaction and the temperature and pulse rate were well controlled. In patients not receiving the sulfonamide before operation the drug was given after operation when the signs suggestive of thyroid crisis occurred, i.e. rapid heart rate, restlessness and a rise in temperature to 101 degrees. In every instance the

temperature and heart rate decreased and the patient's condition improved. This also occurred when sulfadiazine was given to patients showing signs of thyroid crises before operation. The effect of the sulfadiazine occurred within 12 hours of its administration. In this group of patients treated with sulfadiazine and Lugol's solution there were no deaths whereas in a similar group of 75 patients receiving Lugol's solution and operated upon there were 4 deaths.

Sulfadiazine undoubtedly helped control any infection that might have been responsible for the rise in temperature. In addition as the drug is known to exert a goiterogenic effect this may also have contributed to its effectiveness. In view however of the rapidity with which the drug controlled the signs of thyroid crises the suggestion is made that sulfadiazine may have had an effect on the extrathyroid mechanism initiating the reaction known as thyroid crisis.

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ACUTE PNEUMOCHOLECYSTITIS

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BY acute pneumocholecystitis is meant an acute infection of the gall bladder characterized by the production of gas within the gall bladder lumen. The diagnosis can be made radiographically the gall bladder being visualized through the contrast medium of gas. The term acute pneumocholecystitis seems preferable to 'pyopneumocholecystitis' as advocated by Simon since there is no certainty that all cases have pus in association with gas. The name emphysematous cholecystitis proposed by Schmidt and Stevenson (17-18) also lacks inclusiveness since the emphysematous pericholecystic infiltration of gas is not invariably present.

The recognition of gas infection of the gall bladder as an entity is almost solely a product of the roentgenological literature. This is understandable because of the almost pathognomonic rôle of roentgenographs. The surgeon should be no less interested for certain peculiar features of this disease pose problems in its surgical management. That gas-forming organisms are frequent inhabitants of the biliary tract has been known for years. These organisms are not unlike those present in the intestinal tract. While a majority of normal and diseased gall bladders are sterile, others contain a wide variety of bacterial flora, headed in frequency by the *Escherichia coli communis* and the *Clostridium perfringens* (1-8). Besides the *Clostridium perfringens*, other gas-forming organisms often difficult to classify, may exist in the bile tract. For the most part they seem to exist as harmless saprophytic inhabitants. Occasionally they manifest themselves by the postmortem production of gas in the bile radiates (21). Demonstration of gas in the gall bladder is perhaps most frequent in fistulas between the gastrointestinal tract and the gall bladder—a condition which bears little clinical relationship to the subject of this paper.

Examination of the literature of the last 45 years has uncovered only 8 bona fide cases.

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of acute pneumocholecystitis. Kirchmayer was evidently the first to draw attention to the condition. In 1925 he described a case of severe acute cholecystitis in a 64 year old male patient who at operation presented a gangrenous gall bladder distended with gas and pus, some of the gas having escaped into the peritoneal cavity through a perforation. Gram positive gas producing anaerobic bacilli without spores were recovered from the gall bladder contents and wall. The gall bladder was removed and recovery was uneventful. No roentgenologic studies were made.

Hegner in 1931 was the first to recognize this disease preoperatively. His patient was a 62 year old man who had symptoms and signs of severe acute cholecystitis. A scout film of the gall bladder area showed a pear-shaped gas shadow corresponding in shape and size to an enlarged gall bladder. During several days observation the amount of the gas increased and small infiltrations of gas bubbles could be demonstrated in the pericholecystic area. At operation emphysema of the gall bladder wall and gas under pressure within the acutely inflamed gall bladder were found. The gall bladder was drained. Death occurred of pulmonary embolism on the fourth postoperative day. No calculi were demonstrated at operation but a large mulberry stone was found in the gall bladder at autopsy. Atypical *Bacillus welchii* were recovered from the gall bladder pus obtained at operation and autopsy.

A year later Simon described a similar case in a 32 year old man. An admission diagnosis of acute cholecystitis was made. On roentgenographic examination gas over a fluid level was demonstrated within the gall bladder. In addition there were small infiltrations of gas in the pericholecystic area. The gastrointestinal series showed no communication between the intestine and the gall bladder although the imprint of the enlarged gall bladder in the adjacent small intestine could be shown. While the general condition of the patient improved, the roentgenogram showed more pericholecys-

tic infiltration so that surgery was performed. When the peritoneum was opened gas and bile stained pus escaped from a pocket at the fundus of the gall bladder. The gall bladder was gangrenous and there were a number of small perforations. Many calculi were present. Cholecystectomy was performed. Direct smears of the pus showed spores and anaerobic type organisms. No culture was made. The patient recovered. Simon thought that the infection might be blood borne.

Schmidt in 1938 added a case of a 38 year old man with symptoms of acute cholecystitis whose roentgenogram showed gas filling the gall bladder but no pericholecystic involvement. Gastrointestinal series ruled out a communication with the intestine or stomach. Spontaneous recovery occurred. The roentgenograms were so similar to those described by Hegner and Simon that Schmidt did not hesitate to consider this a case of gas infection of the gall bladder despite lack of operative or autopsy proof. Some hint as to the mechanism of recovery could be obtained from the cholecystograms taken during partial recovery when the cystic duct was sufficiently patent to permit entrance and some concentration of the dye.

In 1940 del Campo and Otoro described 2 cases in which the bile tract could be visualized radiographically. In the first case there was a fistulous communication with the gastrointestinal tract and it cannot be included in this series. The second case was a 74 year old man who presented symptoms of acute cholecystitis. The initial roentgenograms showed no gas in the bile tract but roentgenograms on the 5th hospital day showed that the medium and large bile ducts were filled with gas although no gas was seen in the gall bladder. When operation was performed the following day a large amount of gas under pressure together with reddish yellow pus was aspirated from the gall bladder. The acutely inflamed organ was drained. *Clostridium perfringens* was recovered from the pus. Death occurred on the fourth postoperative day. The postmortem examination revealed numerous large calculi in the gall bladder and common bile duct one impacted in the ampulla of Vater. Necrotic areas containing gas were

found in the lungs myocardium kidneys and liver but these were not cultured. This case differs considerably from the others its inclusion in this series may be open to question.

Stevenson (17 18) in 1944 described 3 cases in men aged 52 63 and 64. All had symptoms and signs of acute cholecystitis. The accidental finding of gas in the gall bladder and pericholecystic tissues led to the diagnosis of emphysematous cholecystitis. Two patients were subjected to surgery and the acutely inflamed and gangrenous gall bladders contained gas pus and calculi. The peritoneal exudate of 1 case was cultured and revealed 'aerobic and anaerobic streptococci'. The third patient presented a similar picture and made a recovery without surgery despite the fact that gas had infiltrated into the pericholecystic tissues. This patient received intensive antiseptic infection therapy including polyvalent antiserum sulfathiazole and roentgen therapy and Stevenson is of the opinion that the treatment may have helped the patient recover without surgery.

The foregoing cases are the only ones falling into this clinical and roentgenologic classification. Other reports demonstrating gas-forming organisms in the gall bladder are not uncommon (5 10 13 19) but they are cases in which *Clostridium perfringens* (Frankel's or Welch's bacillus) was found in routine cultures from pus recovered at operation or autopsy. Mention of gas in the gall bladders was not made except in the case of Hallé and Marquéz in which on postmortem examination gas was present in the gall bladder and liver very likely a postmortem change.

CASE REPORTS

CASE 1: H. W. white male, aged 52 years, was admitted to the Jewish Hospital of St. Louis on October 3, 1946, 2 days after the onset of epigastric and right upper quadrant pain radiating to the back and midthorax, and followed by a bloated feeling and nausea. Two hours after the onset he was seen by a physician who administered morphine. This treatment was effective during his only previous similar attack of pain 4 months earlier following which an electrocardiogram showed a normal cardiac mechanism. He slept for 8 hours and awakened with a continuation of right upper quadrant pain the radiation to the back and thorax having subsided. Several loose bowel movements were noted after the onset subsequently the bowels were constive. When



Fig. 1. Case 1. Flat plate of gall bladder area showing pear shaped gas-containing gall bladder. The gall bladder is sharply outlined and there is no gas in the pericholecystic tissues.



Fig. 2. Case 1. Eight days later the gall bladder shows increase in size and now assumes more globular outline. The margins of the gall bladder are irregular due to gas infiltrating into the pericholecystic tissues.

his physician felt a tender mass in the right upper quadrant the patient was admitted with a clinical diagnosis of acute cholecystitis.

Physical examination. The patient was a middle aged man apprehensive, perspiring freely, and complaining of constant abdominal pain. The clinical appearance belied the low temperature (100.6 rectal) and slow pulse rate (84 per minute). The sclerae were faintly icteric. The upper abdomen remained splinted on deep breathing. Intestinal peristalsis was audible. A smooth, very tender globular mass 3 inches in diameter extended below the right costal margin and merged with respiration. On either side of the mass the liver edge could be felt one to two fingerbreadths below the costal margin. Palpation was easiest accomplished by light pressure, deeper pressure causing enough muscle guard to obscure the mass. R bound tenderness was minimal.

Laboratory data. Urinalysis was negative except for two-plus urobilinogen. White blood cells numbered 13,800, red blood cells 4,080,000, hemoglobin 12.8 grams. Differential count showed basophil 0, eosinophils 2, myelocytes 0, juvenile form 0, stab form 16, segmented form 67, lymphocytes 14, monocytes 1. Diastase 35, nonprotein nitrogen 19, blood sugar 107, Kahn negative, cholesterol 303, icterus index 10, total protein 5.8, albumin 3.0, globulin 2.8.

Course. Admission roentgenograms showed the gall bladder distended with gas, the wall sharply outlined (Fig. 1). Because the optimum period for performing cholecystectomy in the acute stage had already passed and because the clinical findings showed some improvement it was decided to postpone operation. The experiences of Schmidt and Stevenson in similar cases, which recovered without operation, somewhat influenced this decision. The patient received 20,000 units of polyvalent gas gangrene antitoxin intramuscularly initially and 10,000 units thereafter every 12 hours. In addition, 50,000 units of penicillin every 3 hours intramuscularly and 1 gram of sulfadiazine every 4 hours were administered. A diet high in carbohydrates and proteins was well tolerated. The temperature and pulse rate remained relatively low and the acute inflammatory signs in the upper abdomen showed some alleviation. But the gall bladder slowly increased in size, and the leucocyte count remained elevated. A roentgenogram made on October 10 showed an increased amount of trapped gas in a more globular gall bladder whose margins were irregular due to gas infiltrating into the pericholecystic tissues (Fig. 2). On October 8 the sulfadiazine and on October 9 the penicillin were discontinued without appreciably altering the clinical course. On October 13 the roentgenogram showed an irregular pattern of gas over



Fig 3. Case 1. Three days later there is an irregular pattern of gaseous infiltration in the gall-bladder bed with widespread pericholecystic infiltration.



Fig 4. Case 1. One day before operation there is an increase in the area of involvement and the size of the gall bladder with less sharp definition of its outline.

infiltration in the gall bladder bed and a more widespread pericholecystic infiltration (Fig 3). In the meanwhile the temperature and pulse rate became normal, although the gall bladder was still enlarged and tender and the leucocyte count remained elevated. For the next few days the condition remained unchanged. Beginning October 19 daily rises in temperature to 100 degrees were noted. On October 21 the roentgenograms showed an increase of gas, both within the gall bladder and in the surrounding tissues (Fig 4).

The following day, October 22 surgery was performed under general anesthesia. A short muscle splitting upper right rectus incision was made directly over the palpable mass. When the peritoneum was opened gas under pressure hissed out of a walled off abscess cavity which included the necrotic fundus of the gall bladder. Then a mixture of bile stained pus and numerous small black, bilirubinate calculi were removed by suction from what was apparently the gall-bladder lumen. Complete examination of the gall bladder was not possible but no large calculus could be demonstrated in the region of the cystic duct. A drainage tube was inserted. No closure was made.

Fresh pus obtained from the gall bladder was sent to the laboratory for culture. Aerobic cultures were made in tryptose-phosphate broth on blood agar

plates and in Endo's medium. Anaerobic cultures were made on blood agar plates and in thioglycollate medium. Particular search was made for *Clostridium perfringens* litmus milk being used but its presence could not be detected. *Streptococcus fecalis* an aerobic and facultatively anaerobic organism which does not produce gas was isolated and identified after growth in milk in 2 per cent and in 6 per cent saline media. An aerobic and facultatively anaerobic member of the paracolon group related to *Escherichia coli* was isolated and identified by cultivation on Kligler's medium the usual sugars milk the tests for indol production the reduction of nitrates to nitrites, Voges-Proskauer reactions and the utilization of citrate. Gram negative nonspore producing anaerobic rods belonging to the *Bacteroides* group which produced no gas in sugar milk or blood serum media were found after repeated thioglycollate cultures. None of the three types of bacteria found was by itself a gas producer. Whether a combination of these organisms could produce gas commensally is not known.

After operation the drainage was first purulent later serous. Occasionally small calculi of the same type as those seen at operation were extruded. No bile drainage occurred at any time. The drainage tube was removed on the eleventh postoperative day and the patient was discharged from the hospital on



Fig. 5. Case 1. The gall bladder is elongated and distended and contains many medium sized nonopaque stones which are visualized by contrast with the gas in the lumen of the gall bladder (arrows). The wall of the gall bladder is visualized by a thin zone of pericholecystic gas.



Fig. 6. Case 2. In this roentgenogram the gall bladder is smaller, the pericholecystic gas infiltration is more marked especially near the neck of the gall bladder (arrows). The calculi and gall bladder wall are less distinct.

the thirteenth postoperative day. The wound healed rapidly to an opening 1 centimeter in diameter and remained in this condition for a number of days. On December 6 a piece of necrotic tissue was seen protruding through this opening. When traction was made on this tissue the necrotic cast of the gall bladder wall was easily and painlessly extracted. The lumen still contained several small calculi. In another week the wound was completely healed and the subsequent course has been uneventful.

CASE 2. M. B., white female aged 57 years, a patient of Dr. C. H. Kilker, was admitted to the Missouri Baptist Hospital on February 20, 1947, with an admission diagnosis of acute cholecystitis. For several years she had had recurrent attacks of epigastric distress, nausea and vomiting, aversion to fatty and fried foods. There was also a tendency to constipation and a recent weight loss over several weeks of 20 pounds. During the previous 3 weeks the attacks had been located more in the right upper quadrant than in the epigastrium and had become increasingly severe and frequent. The attack for which she was admitted was of 2 days duration. It was the most severe one and was accompanied by vomiting.

Physical examination disclosed a middle aged woman in considerable distress from abdominal pain.

The rectal temperature was 101 degrees and the pulse rate 90 per minute. There was marked tenderness, rigidity and rebound pain in the right upper quadrant and epigastrium. A smooth tender mass moving with respiration suggestive of the gall bladder could be made out.

Urinalysis was negative. White blood cells numbered 15,600. Differential count revealed basophils 0, eosinophils 0, myelocytes 0, juvenile forms 0, stab form 20, segmented form 57, lymphocytes 14, mononuclears 0. Kahn reaction negative.

A roentgenogram taken February 21, the day after admission, showed an elongated gall bladder distended with gas. The wall was easily identified by a thin zone of pericholecystic gas and in the fundus multiple shadows suggestive of calculi were present (Fig. 5). The patient received 30,000 units of penicillin intramuscularly every 3 hours. No sulfonamides or gas gangrene antitoxin were administered. A high carbohydrate diet was well tolerated. Considerable improvement in the general condition was noted and the local tenderness and rigidity decreased although the gall bladder remained enlarged and tender. On February 22 the roentgenogram showed essentially the same findings. X-ray examinations were repeated on February 27 following the administration of dye. No dye entered the gall bladder.

der but the organ was again visible by virtue of its distention with gas. The calculi and gall bladder wall were less distinct and some escape of gas into the pericholecystic area could be made out (Fig. 6). The penicillin was discontinued on February 26. Because of the persistently enlarged and tender gall bladder it was decided to perform surgery. On March 3 under cyclopropane and curare anesthesia the abdomen was entered through and upper right rectus muscle-splitting incision. The gall bladder was obscured by an adherent mass of omental and intestinal adhesions, many of which allowed the escape of gas probably trapped outside the gall bladder wall. The gall bladder was tense, acutely inflamed and its wall presented small gangrenous patches through which the gas had apparently escaped but no gross perforation was visible. It removed after considerable difficulty and there was spillage of purulent medium-sized faceted calculi together with escape of gas from the lumen. During removal a calculus was dislodged from the region of the cystic duct (this was collected for bacteriologic studies). Sulfathiazole crystals were sprinkled into the area and the abdomen was closed in layers without drainage.

Identification of the organism proved most difficult. Numerous cultures and subcultures were made in a wide array of media and after several months study the organism was identified as *Clostridium histolyticum*. This clostridium is occasionally present in human stool but information as to whether it has been recovered from the human gall bladder is not at hand. It is an obligate anaerobe closely related to *Clostridium perfringens* which produces terminally or subterminally round spores, which do not cause swelling of the organism. It hemolytic properties vary. It produces acid and gas from dextrose and lactose although saccharolytic powers are limited. Since no other organism was detected it is assumed that *Clostridium* form was the gas-forming organism in this case.

After operation penicillin was again given for a week. Sodium sulfadiazine 6 gram daily was administered intravenously from March 5 to March 10. There was profuse purulent drainage for several days but this diminished gradually. On March 13 the drain was removed. By March 25 the wound had completely healed and the patient was discharged.

Chart 1 is a graphic representation of the clinical course of the two cases.

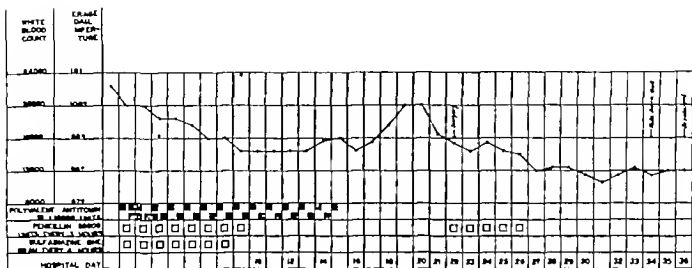
DISCUSSION

An appraisal of the cases of acute pneumocholecystitis brings forth a number of interesting facts (Table I). All the patients but one were male—a circumstance which none of the associated data seems to explain. In most of the cases the condition occurred in the sixth and seventh decades of life but in 2 it occurred in the fourth decade. One would suppose in consideration of the usual picture of gas bacil-

lus infections elsewhere that acute pneumocholecystitis is a fulminating and invariably fatal disease. This was not true except in the case of Del Campo and Otero. The composite picture is one of persistent acute upper abdominal pain usually after previous attacks of pain associated with the gall bladder. The temperature is elevated but not to a high degree. Tenderness and rigidity are prominent features and when the rigidity permits, the gall bladder and occasionally the liver edge can be felt. When icterus is present, it is not marked. This picture of acute inflammation of the gall bladder is not unlike that of other cases of acute cholecystitis or empyema of the gall bladder. In fact there is little to indicate how cases of acute pneumocholecystitis can be distinguished without roentgenology from the general run of acute gall bladder infection without the presence of gas in the gall bladder. There is however a tendency for the inflammatory signs to persist and failure of the attack to resolve would lead one to consider the development of gangrene and perforation complications which certainly do not depend upon the existence of a gas infection. It is evident therefore that the presence of gas in an acutely inflamed gall bladder is an incidental finding although as will be shown, its presence makes for additional problems.

In evaluating the significance of the rôle of gas in acute pneumocholecystitis certain considerations of etiological importance in ordinary cases of acute cholecystitis should be discussed. There is now rather universal agreement that a prime etiologic factor is obstruction at the outlet of the gall bladder (4, 22). Berk reported that blockage of the outlet of the gall bladder by calculi was found in over 92 per cent of the cases of acute cholecystitis collected from the literature. Other causes of obstruction have been noted for example angulations and kinks at the junction of the cystic duct and gall bladder, anomalous cystic blood vessels, adhesions and fibrosis, periduodenitis, enlarged lymph nodes, etc.¹ That obstruction alone generally does

¹ To explain these rare cases of acute cholecystitis in which no obstruction is found, some have postulated the reflex of pancreatic enzymes which upon becoming activated by bile produce inflammatory changes of the gall bladder (5). A possible mechanism for this reflex has been demonstrated experimentally (6).



Case 1

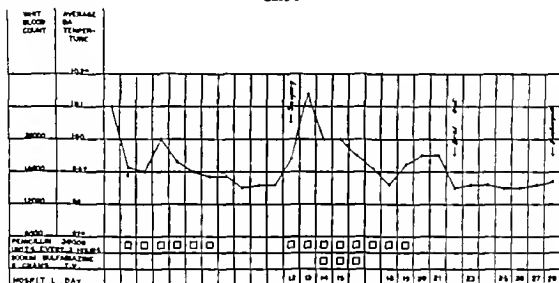


Chart 1

Case 2.

not lead to acute cholecystitis seems well established. Womack and Bricker found no evidence of cholecystitis after occlusion of the cystic duct in dogs if the bile imprisoned within the gall bladder was replaced by saline. They demonstrated that the components of bile itself were partly responsible for the production of acute cholecystitis. The evidence is overwhelmingly against the primary rôle of bacteria in acute cholecystitis. Bacteriologic studies of normal and diseased gall bladders by Andrews and Henry, Eliason and Stevens, and others conclude that at least 50 per cent of gall bladders of all types normal chronic acutely inflamed acutely inflamed with or without calculi contain no culturable bacterial flora. The remainder of the cases contained a

bacterial flora of varying richness and variety a flora which frequently bears a close resemblance to that of the intestine indicating perhaps reflux communication between the intestine and the biliary tract.¹ The cases of acute pneumocholecystitis presented here show a similar lack of uniform bacterial flora (Bacteriological studies in these cases were supervised by Dr. Moyer Fleisher). While the bacteriological studies leave much to be desired sufficient studies have been done to indicate that these cases have been associated with a variety of organisms aerobic anaerobic facultatively aerobic, atypical *Bacillus welchii* anaerobic spores, etc. In the cases in which

It must be concluded that the *Clostridium falliforme* recovered from Case 2 originated in the intestine.

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Those who have had the opportunity to treat cases of acute pneumocholecystitis have done so with considerable apprehension. The facts do not indicate that this anxiety is justified to a much greater degree than in other cases of acute cholecystitis. True no group of cases bearing a mortality rate of 20 per cent can be dismissed lightly. The causes for the fatalities however are interesting. One death was proved to be due to pulmonary embolism, a complication not necessarily associated with the gas infection. The other death was the only case from which *Clostridium perfringens* was recovered. This patient showed involvement of other parts of the biliary system and remote organs facts which cast some doubt on the validity of including it in this series. The favorable outcome of the other cases contradicts the conclusion of Walters and Snell that gas infection of the gall bladder usually terminates fatally.

Pneumocholecystitis can be differentiated from the usual variety of acute cholecystitis only by the roentgenogram. While the cholecystogram is not indicated in acute cases the scout film of the gall bladder area will aid in identifying this unusual type of infection. More general use of the plain film in clinical cholecystic disease may uncover many more cases of pneumocholecystitis than have been recognized previously and prepare the surgeon for a more intelligent approach to the distinctive problems which this condition presents.

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Eight cases of acute pneumocholecystitis have been collected from the literature and

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Necrosis of the gall bladder with perforation is a frequent finding. However the virulence of the infection is relatively less than in gas bacillus infections elsewhere in the body.

Bacteriologically, no constant distinctive organisms are demonstrable.

Surgical therapy alone is effective since the gall bladder wall is subject to greater tension when gas is present and there is a consequent greater risk of gangrene and perforation.

Polyvalent gas antiserum, sulfonamides, penicillin and roentgen therapy are of questionable value in the management of acute pneumocholecystitis.

Routine scout films of the gall bladder area in clinical cholecystic disease will aid in the recognition of this distinctive form of acute cholecystitis.

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studies have been directed to the presence of gas-forming organisms. *Clostridium perfringens* has been looked for but seldom seen in spite of the fact that recognition of the organism poses no inordinate problems. It is likely then that the infections of the gall bladder which produce gas are rarely associated with *Clostridium perfringens* but instead with other gas-forming organisms. Another inference is that the development of acute cholecystitis in these cases occurs independent of the bacteria present and the formation of gas is a rare complication which depends upon the presence of a gas-former within the gall bladder at the time and more important upon conditions enhancing their gas-producing potentialities. That these poorly understood conditions are important can be adduced from the fact that many acute gall bladders contain *Clostridium perfringens* and other gas-forming organisms without producing gas.

It might be argued that the cases of Schmidt and one of Stevenson's cases (17) lacking surgical confirmation should not be included in this group of cases. This poses the question does the finding of gas in the gall bladder indicate an acute pneumocholecystitis? Not usually. Perhaps an even more common cause of gas in the gall bladder is a fistula between this organ and the gastrointestinal tract. It should also be noted that gas may accumulate in the gall bladder as well as in other organs in cases of generalized perfringens infection and as a postmortem change. If these possible sources are ruled out the finding of gas in the gall bladder accompanied by clinical evidence of acute cholecystitis must be considered indicative of acute pneumocholecystitis.

The preoperative recognition of acute pneumocholecystitis presents certain problems in its management. The administration of polyvalent antiserum perhaps first comes to mind, and was employed in 2 cases of this series. Its effectiveness is open to question as might well be expected where the gas-forming organism seems to play a secondary rôle. It is true that the patient to whom Stevenson gave it recovered without surgery, but so did Schmidt's patient who received no antiserum. The profuse use of antiserum in Case 1 of this report

seems to have little altered the course of the disease. The antisera available would probably not be effective against most of the infections because of lack of specificity. Moreover the effectiveness of antisera for gas infection in general has been subject to dispute. (6) The sulfonamides and penicillin likewise were employed in some of these cases, and while their effectiveness cannot be disproved the course of the cases in which they were employed did not differ significantly from those in which they were not. Here, too, these therapeutic agents have not been especially effective in gas gangrene. (14) Roentgen therapy used only by Stevenson, has yet to prove its effectiveness for acute pneumocholecystitis as well as for ordinary gas gangrene.

This brings us to the discussion of the surgical therapy which alone seems effective. Since acute pneumocholecystitis behaves for its most part as do other types of acute cholecystitis the first impulse would be to treat the two conditions alike. Unfortunately there is considerable disagreement as to the correct management of acutely infected gall bladders; some prefer emergency cholecystectomy in the hope of avoiding the complications of gangrene and perforation and of decreasing the mortality and mortality rates while others choose a more conservative course delaying surgery until complications are imminent or until a quiescent period occurs. It is not within the scope of this discussion to present the arguments on either side of this controversy but it should be mentioned that we employ either early or delayed surgery in our cases, attempting to follow a course which seems best suited for the particular case at hand. Cases of acute pneumocholecystitis could presumably be handled similarly were it not for the fact that the mechanics of gas production considerably alter the situation. While the element of infection is not significantly different there can be little doubt that the gall bladder walls are subject to greater tension when gas is present and consequently to an increased risk of gangrene and perforation. The tendency for the wall to become necrotic and for gas to escape into the pericholecystic tissues so frequently demonstrated in this series, indicates a much greater incidence of complications than in non-

gas-producing infection. Accordingly the demonstration of gas in an acutely inflamed gall bladder should strongly favor a decision for early surgery even emergency surgery. The procedure of choice would seem to be cholecystectomy particularly in the first stages of inflammation. Experience with several of these cases has demonstrated that spillage of pus locally in the peritoneal cavity has been well tolerated. Cholecystostomy may be and has been judiciously used when condition preclude removal of the gall bladder. Accidental spillage of gall bladder content during operation should not be unduly feared.

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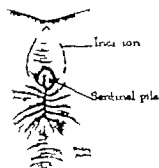


Fig. 1

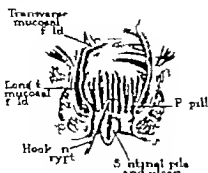


Fig. 2

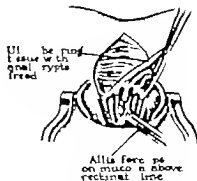


Fig. 3

Fig. 1 The sentinel pile with the ulcer and the delineation of the incision in the posterior arc of the perianal area.

Fig. 2 The anal ulcer with the associated anal crypt, sentinel pile and fibroepithelial polyp (papilla). Note the

component parts of the external anal sphincter muscle (Also see Fig. 7)

Fig. 3 The dissection of the ulcer bearing tissues with associated involved anal structures.

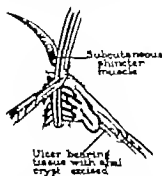


Fig. 4

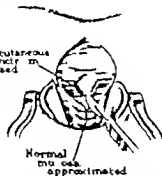


Fig. 5

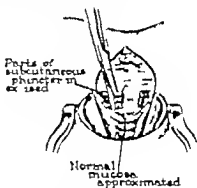


Fig. 6

Fig. 4 The application of the crushing clamp to the subcutaneous portion well above the pectinate line.

Fig. 5 Incision in the midline posteriorly of the subcutaneous portion of the external anal sphincter muscle

(classical posterior sphincterotomy)

Fig. 6 Excision of a part of the subcutaneous portion of the external anal sphincter muscle (modified posterior sphincterotomy)

ANESTHESIA

The anesthetic of choice is one that will produce the best relaxation of the muscles of the anal canal and perineum. My choice is spinal anesthesia produced by 5 to 6 milligrams of pontocaine hydrochloride (dimethyl aminoethyl p-n butylaminobenzoate hydrochloride) in 1 to 2 cubic centimeters of spinal fluid or 25 to 50 milligrams of procaine hydrochloride crystals dissolved in 1 cubic centimeter of spinal fluid which are injected between the third and fourth lumbar vertebrae. Saddle block anesthesia confined to the perianal and perineal areas may be effected by keeping the patient in the sitting position for about 30 seconds after the completion of the intraspinal injection. The incidence of post spinal headaches has been reduced by employing small puncture needles (22 to 25 gauge)

by keeping the patient in a horizontal position for from 8 to 24 hours after operation and by hydration. If headaches do occur they can be relieved by hydration through parental and enteral routes with 2,000 to 3,000 cubic centimeters of 5 per cent dextrose solution with or without saline. The administration of the sodium salt of niacin also has been suggested but its efficacy remains to be proved. This vitamin is given intravenously in doses of 100 milligrams (about 2 grains) and repeated if necessary. This substance also may be administered orally in doses of 200 to 400 milligrams (4 to 8 grains) 3 to 4 times daily with hydration.

Caudal and transsacral block anesthesia also may be employed. This is an effective but a difficult and time-consuming procedure even in the hands of an expert anesthetist. Be-

THE SURGICAL TREATMENT OF CHRONIC ANAL FISSURE

ROBERT TURELL, M.D. New York New York

CHRONIC anal ulcers (fissures)¹ are usually found in the posterior arc of the anal canal although they may occur in other parts of the anal outlet. This lesion is invariably associated with adjacent and subjacent induration and inflammation infection or inflammation of the preformed anal ducts anal glands, and anal crypts. Spasm (dysfunction) and fibrosis of the subcutaneous component of the external anal sphincter muscle also are frequently encountered. A sentinel pile and fibroepithelial polyps (hypertrophied papillae) frequently accompany chronic anal ulcers (Figs. 1 and 2). In agreement with Morgan I ascribe the prevalence of anal ulcers in the posterior aspect of the anal canal to the preponderance of anal crypts and the consequent greater likelihood of infection in this anatomic area (5).

An attempt has also been made to explain the pathogenesis of anal ulcer on the basis of the peculiar anatomic arrangement of the various components of the external anal sphincter muscle (1) and to the anatomic relationship of the posterior anal wall to the posterior rectal wall (2). The superficial component of the external anal sphincter muscle has a Y-shaped origin and insertion; it lies above and external to the subcutaneous component which is an unsupported circular muscle surrounding the anal canal. Thus the subcutaneous portion of the external anal sphincter muscle lies like a bar across the crook of a Y and is according to Blaisdell (1) subject to frequent defecatory trauma; this subcutaneous sphincteric component has no influence upon anal incontinence. Blaisdell pointed out that because the junction of the posterior walls of the rectum and anus forms a right angle the sphincteric muscle is vulnerable to trauma which is produced by the weight of the fecal mass.

The treatment of chronic anal ulcer is always surgical. In this paper a rational operative procedure based on the experience obtained in civilian and military practice in the treatment of 270 patients, is described and illustrated. The operation comprises wide excision of the ulcer bearing area the extirpation of the involved anal crypt or crypts with the sentinel pile and polyps, and the performance of a posterior sphincterotomy (Figs. 3, 4, 5 and 6). The accompanying drawings are based on sketches made by the artist in the operating room.

PREOPERATIVE MANAGEMENT

The patient is admitted to the hospital one 12 hours prior to operation. The perineal and perianal regions are shaved and washed with soap and water. The dorsolumbar portion of the back is also shaved washed with soap and water painted with a tincture containing 3 per cent of iodine and covered with a sterile towel which is held in place by means of adhesive plaster. The intestinal preparation consists of a saline enema given 6 to 8 hours before operation.

Suitable sedation consists of the oral administration of a drug of the barbiturate group. Usually a long acting barbiturate, such as phenobarbital in a dose of 0.090 gram (1½ grains) is given orally about 8 to 12 hours before operation and a short acting barbiturate such as pentobarbital sodium (nembutal) or sodium propylmethylcarbonyl allyl barbiturate (seconal) is administered in doses of 0.090 gram (1½ grains) 1 to 2 hours before the scheduled time of the operation. Morphine sulfate 0.011 to 0.016 gram (¼ to ¼ grain) or demerol hydrochloride 0.100 gram (1½ grains) with atropine sulfate 0.00032 gram (1/150 grain) or scopolamine hydrobromide 0.00032 gram (1/200 grain) is administered subcutaneously 60 to 90 minutes before the patient leaves for the operating pavilion.

¹Regarding the use anal ulcers and "anal fissures, these terms are used interchangeably in this article.

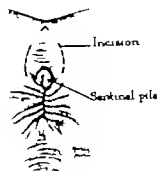


Fig. 1

Fig. 1 The sentinel pile with the ulcer and the delineation of the incision in the posterior arc of the perianal area.

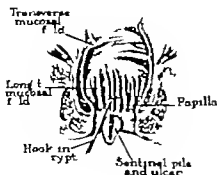


Fig. 2

Fig. 2 The anal ulcer with the associated anal crypt, sentinel pile, and fibroepithelial polyp (papilla). Note the

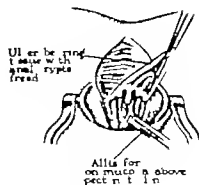


Fig. 3

component parts of the external anal sphincter muscle (Also see Fig. 7)

Fig. 3 The dissection of the ulcer bearing tissues with associated involved anal structures.

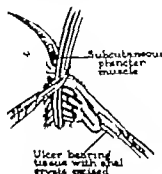


Fig. 4

Fig. 4 The application of the crushing clamp to the mucosal pedicle well above the pectinate line

Fig. 5 Incision in the midline posteriorly of the subcutaneous portion of the external anal sphincter muscle

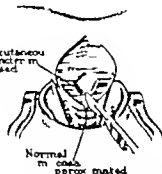


Fig. 5

(classical posterior sphincterotomy)

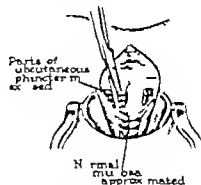


Fig. 6

Fig. 6 Excision of a part of the subcutaneous portion of the external anal sphincter muscle (modified posterior sphincterotomy)

ANESTHESIA

The anesthetic of choice is one that will produce the best relaxation of the muscles of the anal canal and perineum. My choice is spinal anesthesia produced by 5 to 6 milligrams of pontocaine hydrochloride (dimethyl aminoethyl p-n butylaminobenzoate hydrochloride) in 1 to 2 cubic centimeters of spinal fluid or 25 to 50 milligrams of procaine hydrochloride crystals dissolved in 1 cubic centimeter of spinal fluid which are injected between the third and fourth lumbar vertebrae. Saddle block anesthesia confined to the perianal and perineal areas may be effected by keeping the patient in the sitting position for about 30 seconds after the completion of the intraspinal injection. The incidence of post spinal headaches has been reduced by employing small puncture needles (22 to 25 gauge)

by keeping the patient in a horizontal position for from 8 to 24 hours after operation and by hydration. If headaches do occur they can be relieved by hydration through parental and enteral routes with 2,000 to 3,000 cubic centimeters of 5 per cent dextrose solution with or without saline. The administration of the sodium salt of niacin also has been suggested but its efficacy remains to be proved. This vitamin is given intravenously in doses of 100 milligrams (about 2 grains) and repeated if necessary. This substance also may be administered orally in doses of 200 to 400 milligrams (4 to 8 grains) 3 to 4 times daily with hydration.

Caudal and transsacral block anesthesia also may be employed. This is an effective but a difficult and time-consuming procedure even in the hands of an expert anesthetist. Be-

cause of the simplicity of execution and the promptness of anesthesia. I prefer spinal to caudal transsacral anesthesia. Inhalation anesthesia usually cyclopropane is employed only when the patient is apprehensive or refuses other types of anesthesia.

With the employment of the technique to be described it has been unnecessary to utilize the long acting anesthetic solutions for the avoidance of postoperative pain. The use of these drugs also has been avoided because they do not afford an anesthetic effect in many instances and because they may produce an aseptic inflammatory reaction of the tissues into which they are injected eventuating in suppuration and necrosis. In many cases there occurs a delay in the healing process of the wound and an increase in scarring.

TECHNIQUE

After induction of anesthesia, the patient is placed in the proper position on the abdomen and the operating table is adjusted so that a modified jackknife inverted position is obtained.

It is my unflinching practice to perform an anoproctosigmoidoscopic examination prior to the admission of the patient to the hospital except in the presence of very painful lesions such as the condition under discussion. In instances such as this the complete proctologic survey is carried out after anesthesia has been induced.

With the patient in the inverted position the operative field is cleansed with alcohol and painted with tincture of alkyldimethyl benzylammonium chlorides (sephuran chloride).

With a retracting operative anoscope in the anal canal a gauze sponge to which a long piece of silk suture material is tied is placed in the rectum well above the proposed operative site and is anchored to the outside by means of a forceps and a pyramidal incision in the perianal skin is made (Fig. 1). Its summit usually extends about 2 centimeters from the anal verge and ends about 1 centimeter above the pectinate line (mucocutaneous junction). Laterally the incision is made about 0.5 centimeter away from the ulcer bearing area and the sentinel pile (Fig. 3).

The ulcer bearing region and the subcutaneous tissues are dissected free. The subcutaneous component of the external anal sphincter muscle is exposed and visualized (to be dealt with subsequently) and the dissection is continued and the integument of the anal canal and the rectal mucosa is freed for a distance of about 1 centimeter above the pectinate line (Fig. 3). This rather wide dissection is done in order to facilitate the excision not only of the ulcer bearing tissues, but also the sources and channels of infection. A Smith crushing clamp is then applied to the mesal pedicle radially in the long axis of the anus and the diseased tissues are excised. The mucosal pedicle may be dealt with in one of several ways two of which are herewith described: (1) interrupted number zero chromic catgut sutures (the exact number varies with the size of the pedicle) are introduced under the clamp and are tied after the clamp is removed and the crushed portion of the mucosa excised (Figs. 5 and 6). (2) a continuous chromic catgut suture is placed beneath the tip of the clamp and tied. This suture is then looped several times around the shank of the clamp. After the latter is released and removed the loose suture is pulled up and tied. The mucosal stump may be anchored to the submucosal tissues in the level of the pectinate line however this maneuver is usually unnecessary.

The subcutaneous portion of the external anal sphincter muscle which in many instances of chronic anal ulcer is fibrosed and atrophied is now incised in the right angle of its fibers (Fig. 5). If considerable fibrosis exists I excise a small part of this muscle, as shown in Figure 6 in order to prevent early reapposition of this muscle and insure ample drainage which in turn promotes better restitution of the inflamed anorectal tissues. This modified sphincterotomy has been performed in over 100 cases with gratifying results.

Associated pathologic anorectal lesions, such as infected anal crypts or fibroepithelial polyps situated in other parts of the anal canal may be excised. Except for hemorrhoids situated close to the ulcer I prefer not to remove concomitant hemorrhoids as these frequently recede after excision of the ulcer.

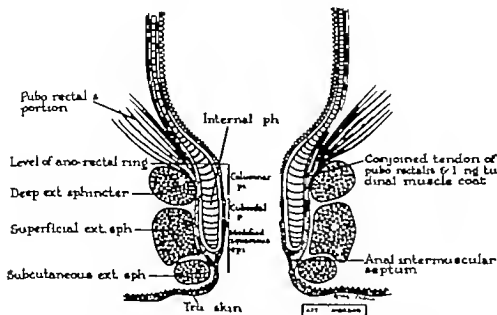


Fig 7 (Also see Fig 3) The component parts of the external anal sphincter muscle. The subcutaneous portion is the most superficial. Since it does not influence anal incontinence, the severance of its continuity may be effected safely.

Hemostasis may be secured by gentle pressure with gauze or by clamping the bleeding points with small artery forceps and tying them with double zero plain catgut. In addition the new hemostatic agents such as the gelatin sponge (with or without thrombin) or oxidized cellulose may be applied to the wounds (4). I still prefer the use of the gelatin sponge to oxidized cellulose because the latter produces local annoying discomfort for a period of 12 to 18 hours after operation has been performed.

At the conclusion of the operation the wounds and the rectum are inspected. The gauze sponge placed in the rectum at the beginning of the operation is now gently removed. This gauze had served as a barrier against blood clots which may cause postoperative tenesmus if not removed. If the biologic hemostatic agents just alluded to are not utilized then either a narrow strip of vaselized gauze or a small sized Penrose drain is left indwelling in the anal canal.

POSTOPERATIVE COURSE

The immediate postoperative convalescence is smooth and uneventful. Pain is controlled by the administration of an analgesic such as morphine sulfate or demerol in the same doses as given preoperatively. Parenteral

analgesics are not required in more than 40 per cent of these patients and do not require narcotic analgesics postoperatively. Acetylsalicylic acid 0.300 to 0.600 gram (5 to 10 grains) with or without phenobarbital 0.030 gram (1/2 grain) is prescribed routinely in order to avoid possible postoperative anxiety.

Catheterization is practiced whenever the patient has suprapubic pain and is unable to urinate in the standing position out of bed regardless of the time interval between catheterizations. It frequently is necessary to recatheterize patients within 2 to 3 hours at times even larger amounts of urine may be obtained at subsequent than at the initial catheterization. Catheterization is usually required in less than 25 per cent of patients. I do not share the opinion that spinal anesthesia is the sole cause of the patient's inability to urinate. Rather I attach more significance to the reflex inhibitory action produced by the operative manipulation of the tissues and their innervation which are in close anatomic proximity to the bladder neck.

Some time after a lapse of 48 hours the gauze packing or Penrose drain is removed. It is of course unnecessary to remove the hemostatic agents as these disintegrate or become absorbed spontaneously in 3 to 5 days. The wound is inspected daily.

A liquid or soft diet with a liberal intake of fluids is given during the first 24 postoperative hours. Thereafter a full house diet which is supplemented by several bananas daily is allowed. Liquid petrolatum in doses of 15 to 20 cubic centimeters ($\frac{1}{2}$ ounce) is given nightly until the wounds are completely healed. Usually a bowel movement occurs between the second and fourth postoperative day when the patient is discharged from the hospital.

A digital examination with the little finger is made between the fifth and the seventh postoperative days. Thereafter this procedure the index finger being used is repeated about once in 5 days to control the rate of healing and to break up any bridging that may occur. Complete healing of the wound usually occurs within 3 to 4 weeks with a resultant soft and pliable scar.

Occasionally probably the result of inadequate supervision there may develop dead space with low grade infection, resulting in a sinus or fistulous tract. This complication occurred twice in the series of operations which is presented herein.

SUMMARY

A successful surgical procedure for the extirpation of chronic anal ulcer as well as the preoperative and postoperative management is described and illustrated.

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REPAIR OF HYPOSPADIAS WITH FREE INLAY SKIN GRAFT

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IT has seemed to us in general that repair of hypospadias has been done at too late an age. Ideally repair of all congenital deformities is better done in early childhood and hypospadias is no exception. Not only is fixation of the physical deformity prevented but psychic difficulties are avoided if repair is done early.

It is probable that repair of hypospadias has been delayed because the small penis of early childhood is not well suited to the flap type of repair most generally used. For this reason we have reviewed the older methods with the idea in mind of selecting a principle of repair which could most nearly meet the requirements of first providing an adequate repair in few operative steps and secondly be practical early in childhood.

HISTORICAL BACKGROUND

The repair of hypospadias, we believe still remains a problem of considerable magnitude judging from the great number of procedures which have appeared in the literature. This is substantiated by an article by Cecil in which he lists 556 references and this list probably does not include all published works on hypospadias. But on analysis there are probably no more than seven surgical principles which have been reported in the past. These can be divided into two major groups: flap repair and free graft repair.

Chronologically these are

- A Construction of urethra with flaps
 - 1 Dieffenbach 1837-45
 - 2 Thiersch Duplay 1860-74
 - 3 Rochet 1899
 - 4 Bucknall 1907
 - 5 Ombredanne 1911
- B Construction of urethra with free graft
 - 1 Nové Jossierand 1897-1914
 - 2 Miscellaneous methods 1900-27

In deciding upon a method the surgical principles in the past have been thoroughly

From The Department of Surgery The University of Rochester School of Medicine and Dentistry and the Strong Memorial Hospital Division of Plastic Surgery and the Division of Urology. Added in part by the Dr. Henry C. Buswell Memorial.

reviewed. Modifications of these fundamental principles have been made but they are so numerous that they could only be considered in a more detailed treatment of the subject. They can be summarized as follows:

A Construction of urethra with flap—

1 Dieffenbach 1837-45 (translation). Building of a tunnel by transplantation. When no duct is in existence and the urine goes out of an opening in the back part of the penis then one makes a new canal of skin. One takes a fold of skin on each side of the penis and draws it together over the place where the urethra should be situated. Here one sews the edges of the skin folds together with a straight needle and a strong thread lengthwise in the manner of a tunnel. Thereupon one makes an incision on both sides of the penis through the skin in order to relieve the tension and finally one cuts the edges of the skin folds sewed together over the passage seam one after the other with a sharp scissors and draws the wound edge together by means of the continuous seam or a quantity of mounting pins (for insects) so that the epidermis will come in contact with epidermis. In order that the new canal may not interrupt the urine this is led away through the old opening with a catheter. If the building of this interior canal by means of skin drawn over is successful then it may be opened from the forepart and continued through the glans. If it has a crack, it will be healed by the bloody suture and then the still closed skin canal will be opened by means of a probe being drawn from the front to the back and a bougie drawn through the glans. The outer opening between the canal and the glans will be closed by spreading on *Tinct. cantharidum*. If however the glans is imperforate then one bores through it with a small trocar and draws into it the urethra. By means of a thick lead probe one tries to skin over the passage on the inside.

Dieffenbach (balanic hypospadias). The perforation of the closed glans is the least of these operations and the result is more sure. On the other hand this operation is doubtful when a longer canal is to be built. The operation proceeds in the following way. One braces the penis firmly and draws it in the same direction as the body then one takes a trocar suited to the age of the patient, which is provided either with a silver or lead pipe into the glans which provides constantly a dummy urethral opening on the under side of the penis along under the skin into the already existing canal of the urethra. Hereupon one draws the stylet out and leaves the lead pipe remaining. The treatment must be very aseptic, and especially the cold wrappings which will be wound around. One exchanges the lead pipe later with a

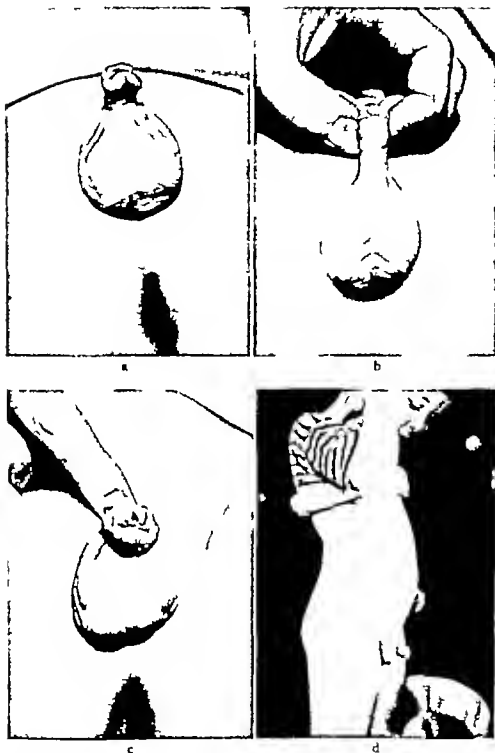


Fig 2 (Case 8) a, Mild penile type of hypospadias with the usual chordee. b, Chordee corrected. Skin on ventral surface lax and urethral orifice well off midline. c, Appearance of reconstructed meatus. d, Five year old child voiding through reconstructed urethra.

applied. A retained catheter is used to draw off the urine. The catheter holding the graft is removed in 8 days and 5 days later the passage of sounds is begun and continued for 3 weeks.

4. Bucknall 1907. Penis is drawn up over the abdomen and scrotum is pulled downward between

the thighs. Incision is made on either side of the urethral area and the scrotal raphe. The two longitudinal flaps thus developed are sutured in such a manner as to bring the raw surfaces of the penile flaps into contact with the raw surfaces of the scrotal flaps and the penile shaft is flexed on the scrotum.

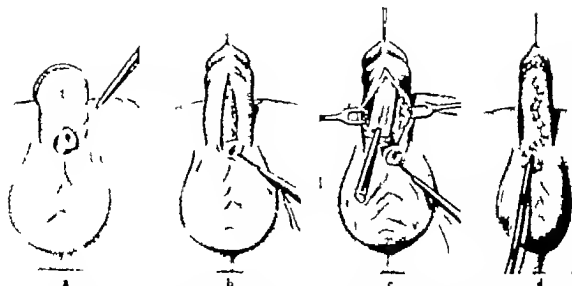


Fig. 3. a. Urethral opening encircled by incision and dissected proximally. b. Incision prolonged longitudinally to frenulum. c. Dissection of fibrous tissue producing chord. d. Skin shifted from dorsum and closure in multiple Z-plasty to prevent lateral contraction. Urethral orifice displaced back and end of the shaft straightened.

The flaps are sutured together. A small rubber tube is passed down the newly constructed urethra to the bottom of the hypospadias meatus and this will maintain the urine. At the end of 4 days the catheter is removed and after 3 to 4 weeks the second procedure can be carried out and delayed for a longer time.

At the time of the second stage the penis and the urethra are dissected off the scrotum and the external skin edges are sutured together. Follow up in 3 cases, how good results 4 years, 2 years, and 3 years after operation.

5. Ombre Lanne 1911. The urethra is constructed by a pedicle flap of skin taken from the ventral surface of the penis behind the meatus to the posterior edge of which it is left unattached. This flap is turned forward by means of a purse-string suture so that its anterior end reaches the inferior surface of the glans where it forms the new meatus. The raw surface thus left is covered by buttoning the hood and bringing it down over the ventral surface of the penis. The total pedicle is divided later. This operation is said to obviate fistula formation but it leaves such a urethra the dribbling from which after micturition is likely to be very inconvenient for the patient especially when several tapes are required to bring the urethra to the end of the penis thus leaving a series of pouches each of which may retain a little urine.

6. Construction of urethra with free graft—

1. Nové Josseland 189, 1914. This method will be considered in detail with a translation of his first article "Treatment of Hypospadias New Method" found in *Proc. Nat. Ass. 189, 85, 105-200*.

Mr. Nové Josseland discusses a new treatment of hypospadias.

On August 18, 1895, he was called to attend a patient with hypospadias in whom he had previously

operated unsuccessfully with the Duplay procedure. He practiced the following operation. A transverse incision 2 millimeters long was made in front of the abnormal opening of the urethra then in the cutaneous cellular tissue under the skin. He introduced a full instrument which severs and separates the loose subcutaneous tissue while proceeding toward the base of the glans and so creates a canal under the side of the sound or rod (sic) a subcutaneous canal the anterior end of which opens, penetrating a little by little with a trocar.

This canal being established it becomes necessary to reinforce it internally with mucosa thus preventing it from closing on itself. For that purpose a piece of skin is taken from the thigh after the manner of Ombre Lanne, a piece of flesh dermoepidermic about 2 centimeters wide and of a variable length depending upon the amount of urethra which it is necessary to reconstruct. This graft is rolled around a No. 16 probe in such a way that the cutaneous surface is outward toward the probe, the growing surface is on the inside and the graft is fastened by two sutures at each end. Then is introduced the probe clothed in the cutaneous canal and the whole is kept in place by a convenient dressing.

At the end of 8 days the probe is withdrawn. The graft has taken perfectly so that there is a new cutaneous double canal of skin for the whole length. Daily catheterizations are started to prevent stricture which in the first few days may cause uneasiness. Now nearly 2 months after intervention the result seems to have been achieved. The canal has remained permeable by a No. 13 probe. During the first days it would admit only a No. 12. It is thus made supple and enlarged and it is hoped to achieve still more in this manner. During the first shaft at first remained very curved but

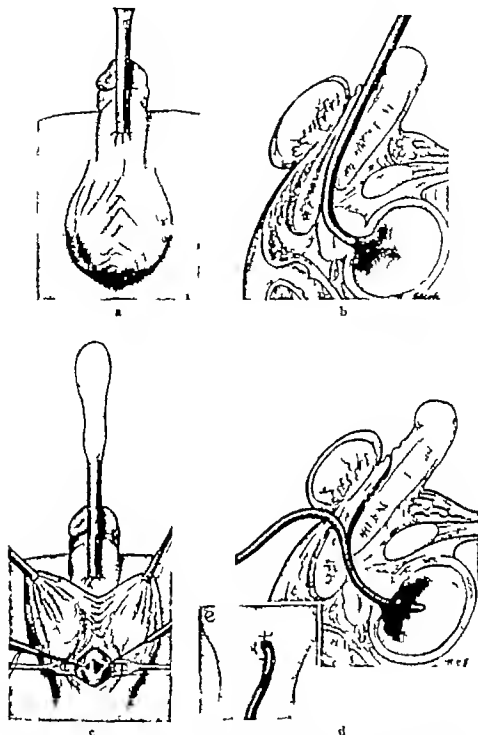


Fig 4. a and b First step in urethral reconstruction sound in place. c, Urethral opened rather high in perineum. d, Foley catheter in place. e, Wound closed snugly around Foley catheter

straightens out perfectly and it would appear possible soon to join the ends of the new canal with the old.

"The results obtained are therefore satisfactory and one may hope for even greater improvement. This is explained by the physiology of the Ollier Thiersch grafts at first they undergo a sufficiently strong retraction but later differing in this from scar tissue they become capable of being made flex-

ible and of yielding under the influence of traction methods.

"This method of treatment appears applicable to all varieties of hypospadias and it seems much preferable to all the other procedures in use today. The procedure of Duplay has had great success without doubt but ordinarily one does not obtain success except at the cost of repeated interventions and re-buffs are not rare. The difficulties of insuring perfect

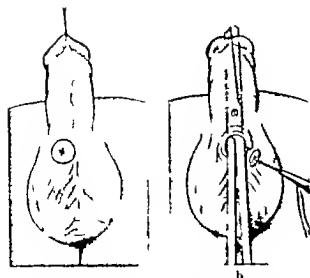


Fig. 5. a Incision to free urethra. Note zigzag scar following chordee correction. b Tunnel made between skin and corpora, emerging through glans at mental depression. Urethra retracted laterally.

asepsis in this region the twitchings inflicted on a thin and fragile skin by erections explain why sutures so often break either partly or entirely. In spite of the precautions taken. All the methods using cut pieces of flesh on the rod are subject to the same criticism.

TABLE I—GIVES THE END-RESULTS REPORTED BY NOVÉ JOSSERAND IN 1914

Cure No.	Type of hypospadias	Age	Result
1	Penile-scrotal		Fistula followed 3 yrs
2	Penis	15 1/2	Good fistula small 4 1/2 years
3	Perifascial pseudobernaphoritis		Good fistula small 7 years
4	Penile-scrotal	15 1/2	Very good—followed 7 years
5	Perifascial	6	6 years—canal good—urine through fistula
6	Penis	13	Stricture
7	Scrotal	14	Good—7 yrs follow up
8	Penis	6	Good—7 1/2 years
9	Penile scrotal	5	Good—6 years
10	Penile-scrotal	7	Good—6 years
11	Scrotal	10	Good—6 years
12	Penile scrotal		Stricture
13	Penile	9	Good—15 1/2 years
14	Penis	Adult	Fistula—4 years
15	Penile (testis-scrotal)	15 1/4	Good—5 years
16	Penis	16	Stricture
17	Penile scrotal	4	Stricture
18	Perifascial	7 1/2	Good—8 months

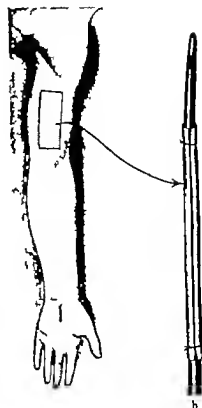


Fig. 6. a. Free graft cut with dermatome from inner anteromedial surface of upper arm. b. Graft fixed in situ with dermatome cement. The 1 suture is to prevent rolling on introduction into tunnel.

"The scrotal flap has also been used with success, but because it should be of certain length it is exposed to mortification at least in part because of the comparative narrowness of the stalk.

In using the dermoepidermic graft one escapes all these inconveniences and one succeeds in an infinitely simpler manner in creating a canal to which one may give in the two senses, the dimensions one wishes. The observations of our patient demonstrates that the canal can persist and preserve its size; one is also permitted to hope that the tendency to contracture is practically conquered, it will become more and more flexible and will give a definitely perfect result."

2 Miscellaneous methods.—Some tissues used for urethral reconstruction: saphenous or some vein, Legueu (1911) ureter, Schmieden (1900) appendix, Weitz (1915) McGuire (1917) Axhausen (1915) vaginal mucosa Legueu (1918)

METHOD

In reviewing these past procedures it appeared that the principle most applicable to children as well as adults and one which could be done in the fewest steps with the smallest

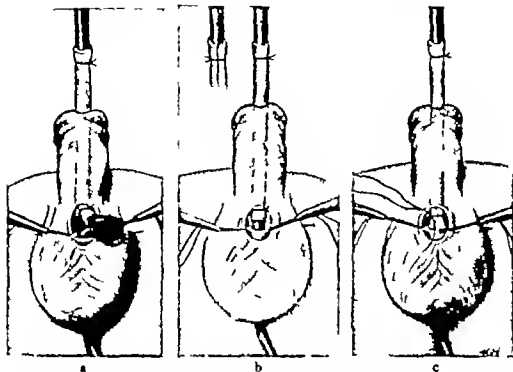


Fig 7 a, Inlay graft in place. b, End of graft bearing catheter introduced into urethra. c, Graft and urethra approximated by suture.

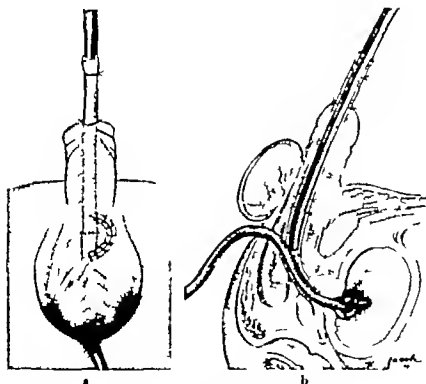


Fig 8 a, Completed urethral reconstruction. Note suture lines do not coincide. b, Sagittal section showing relationships of catheter, ligatures, and suture lines.

possibility of multiple fistula formation was that of Nové Josseland. All of the repairs based on the principle of flaps involve numer-

ous operative steps are difficult to do on a tiny penis and frequently result in multiple fistulas which may be worse than the original



FIG. 9 (Case) a. An extreme pseudohermaphroditic deformity. The penis is completely adherent on its ventral surface. b. In this type of deformity the urethral orifice

remains free posteriorly in the perineum. c. Final result. Good urinary stream years after urethral reconstruction.

condition. It is probable that reconstruction of the urethra by a free skin graft has never been widely used first because urologists who mainly attend these conditions were not familiar with the principles of skin grafting and second because as originally described the possibility of contracture of the constructed urethra was ever present. It is of interest that Nové-Josseland described free graft repair of hypospadias in 1897. The graft he used was an Ollier Thiersch graft described and developed from 1872-86 by Ollier and Thiersch. It is well known that the thin Thiersch graft has a high percentage of contracture. Despite this Nové-Josseland was able to obtain good results in 9 of 18 cases which he reported in 1914.

The principle has been sporadically used without much modification. In general the plan has been to construct a tunnel with a free skin graft around a catheter from the site of the urethral ending out through the glans. This tunnel is then kept open by repeated dilations over a period of months. A good example of this without modification is the report by McIndoe in which the tunnel is dilated for some months. When it is finally judged past the contractile phase an attempt is made to join the urethra to the tunnel by a second

operation. As repeated dilations are difficult in small children the operation as usual done is more applicable to adults, which is evidenced by McIndoe's paper.

As we know skin grafts have greatly improved since Nové-Josseland's day so the more uniform grafts with less tendency to contract are now available. In addition, the Foley indwelling catheter as well as chemotherapy and antibiotic methods of controlling infection has been devised. All of these factors caused us to believe that it was feasible to attempt to construct the urethra in one step even in small children.

OPERATIVE PROCEDURE

Correction of chordee. As in all reconstructive procedures a method gradually evolves and our experience is no exception. The steps reported are those which we are now using. In brief we attempt to correct the chordee at one operation. This is done quite early if the patient is seen in infancy at about one year of age. In this respect most surgeons concerned with correction of chordee seem to agree. The advantages have been enumerated many times but for the sake of clarity they are (1) The chordee should be completely

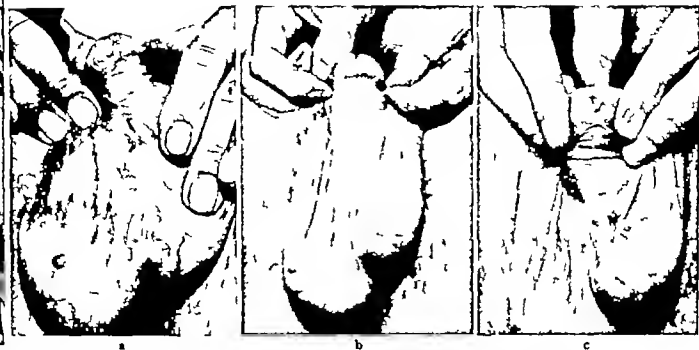


Fig 10 (Case 2) a Conditions in which patient first presented himself. Chordee had been satisfactorily corrected elsewhere. b, Ventral view following urethral reconstruction. c, Reconstructed meatus in glans.

corrected before the urethra is reconstructed (2) Early correction of the deformity permits earlier urethral reconstruction (3) Growth proceeds more normally (4) Deformities in general are more easily corrected before they become fixed by growth

The objective of the first operation is to obtain a straight penis with lax skin on the ventral surface and if possible a plan which will prevent recontracture to any extent. In addition we have found that it helps prevent fistula formation when the urethra is constructed if the urethral orifice is off the midline (Fig 2b)

The first step is to dissect free the urethral opening. This dissection is carried proximally depending on the extent of contracture. In any event one must be certain to excise all of the fibrous tissue which holds the penis in the curved position. The urethra is freed by a circular incision and the dissection freeing it is done with a sound in place. When the proximal extent of the fibrous band is located the urethra is retracted out of the way with stay sutures and the band is dissected out beginning proximally. The skin is incised from the circular opening to the frenulum and dissected free on either side thus exposing the contracture. The dissection of the band proceeds

along the corpora cavernosa and must be quite close to it. In some instances Buck's fascia seems contracted and in order to secure complete straightening of the shaft must be cross-cut. At this stage the corpora cavernosa are plainly seen. The urethral orifice has dropped backward and it should be possible to hyperextend the penis without any ventral tightness. Once the deformity has been corrected one must attempt to prevent postoperative scar contracture causing a partial return of the deformity. If the skin of the penis is closed longitudinally as in the Heineke Mikulicz principle this is almost sure to happen. To avoid this the closure is staggered in multiple fashion by imbrication of triangular flaps. The most proximal of these is made so that the urethral opening is displaced from the midline. At the extreme distal end of the shaft skin may be deficient and if so skin is brought to the ventral surface from the hood. This is accomplished by making a dorsal slit in the hood, dissecting off and discarding the mucosal surface and transplanting the halves of the hood skin to the ventral surface of the shaft (Fig 3) (We have in some instances used the preputial mucosa for the urethral graft but in most cases there is not enough present for the full length of the urethra). The glans

TABLE II—ANALYSIS OF 10 CASES WITH IMMEDIATE AND LATE END-RESULTS

Case and unit number	Type of hypospadias	Age chordee corrected		Age urethra reconstructed	Results	
		Elsewhere	Circumcise		Immediate	Final
1. S. S. M. H. 4663	Perineal scrotal periorchidectomy phalloplasty		8 mos	3 yrs.	Small fistula	Closed completely 7 yrs. Excellent
2. H. B. S. M. H. 0430	Penile scrotal	Completed		39 yrs.	Urethra intact	Excellent 7 yrs.
3. J. C. S. M. H. 0603	Penile scrotal	Partially corrected		Chordee corrected and urethra reconstructed—age 3 1/2 yrs.	Pressure necrosis from dressing—large fistula	Final result excellent 7 yrs. or later 1/2 closed 4 yrs. or later 1/2 excellent
4. O. F. S. M. H. 19669	Penile scrotal	Completed 9 yrs.		7 yrs.	Tiny fistula	Excellent 7 yrs. or later 1/2 excellent
5. J. B. S. M. H. 21594	Penile scrotal	Incomplete 1 yr	7 yrs.	7 yrs.	Flap fistula	Fistula closed 7 yrs. Excellent 7 yrs. or later 1/2 excellent
6. A. S. S. M. H. 11230	Penile scrotal	Incomplete 1 yr	14 yrs.	5 yrs.	Excellent	Excellent 7 yrs.
7. D. R. S. M. H. 28637	Penile scrotal	Complete 7 yrs.		7 yrs.	Excellent	Excellent 7 yrs. or later 1/2 excellent
8. H. F. S. M. H. 64794	Midpenile		4 yrs.	14 1/2 yrs.	Excellent	Excellent 7 yrs.
9. W. C. S. M. H. 26318	Midpenile		8 yrs.	9 yrs.	Excellent	Excellent 7 yrs. or later 1/2 excellent
10. R. S. S. M. H. 66824	Perineal scrotal periorchidectomy phalloplasty		7 yrs.	1 1/2 yrs.	Small fistula from pressure necrosis from dressing—large fistula	Final result excellent 7 yrs. or later 1/2 closed 4 yrs. or later 1/2 excellent

the graft and a stitch transfixes glans catheter graft, and abdominal skin. Thus the penis is held in hyperextension (Fig. 8).

The position on the abdomen facilitates the application of a compression dressing. Originally we immobilized the legs in an abducted position with plaster but we no longer do this as a simple compression dressing seems effective. In children the arms and legs are restrained. Originally we kept the graft bearing catheter in the penis for 14 days and the perineal catheter for 3 to 4 days longer. As we gained more experience this time has been gradually decreased. We noted that at 6 or 7 days there was often mucopurulent discharge at the glans meatus and similar discharge at the suture line on the shaft. Therefore we at present remove the catheter from the penis at 7 days and the indwelling perineal catheter on

the next day. The patient is kept in order to wash out the catheter. The catheter may then be inserted into the bladder if the penis does not close in 2 or 3 days.

DISCUSSION OF IMMEDIATE

It is now 7 years since we first reported our plan of hypospadias repair. In the 7 years we have completed 10 cases. The results can be summarized as follows: There are several other cases in which the chordee has been corrected but the urethra has not elapsed to allow for a normal erection. From these cases it is evident that the outlined for chordee repair is not satisfactory. In no case has there been an appreciable return of chordee after repair and nor has a significant

chordae been necessary. This statement applies not only to the penile type of hypospadias where the curvature is mild, but also to the severe pseudohermaphroditic deformities.

In the 10 cases in which the urethra has been constructed at one operation 3 have healed *per primam* with no leakage at any time and have voided through an adequate orifice in the glans penis as soon as the catheters were removed (Fig. 2).

One other case should probably be included as an excellent immediate result in the group above since in this instance a tiny fistula at the anastomosis closed spontaneously in 3 weeks. In 2 other cases a small fistula persisted at the anastomosis which had been operatively closed.

Three other cases have small fistulas at the anastomosis and are awaiting closure. We have found that it is not wise to attempt immediate closure of a fistula at the anastomosis because in some instances the fistula will close spontaneously in a few weeks and in others will shrink greatly over a period of 3 to 4 months. Actually these cases of fistula might be classed as good results by some observers because 2 of the 3 patients are voiding 95 per cent of the urine through the glans. In any event an attempt to close the anastomotic fistula must wait complete softening of the tissues in order to be successful.

In one instance we have had a persistent perineal urethrostomy fistula which had to be closed operatively. From these data it would seem that one can expect about 50 per cent excellent immediate results from the plan as outlined. It is worth noting that in no instance has there been a failure of the inlay graft taking. Furthermore fistula formation when it does occur is limited to the site of the urethral-graft anastomosis.

In the past we believe that the main reason for not using a free graft for urethral construction has been the fear of contracture and stricture. A follow up of our cases does not bear this out. At first we also had this lurking fear and dilated the constructed penile urethra frequently. We noted that this was often accompanied by bleeding and, of course considerable discomfort. Because it seemed that the continual trauma would predispose to

more scar tissue formation we abandoned frequent dilation and to our surprise found that the caliber of the stream in most instances actually improved. Evidently the urethral stream is sufficient dilation in those instances where it passes through the urethra. Since the urine comes through an anastomotic fistula, more frequent observation and passing of sounds to determine whether dilation necessary is advisable. The caliber of the stream is the best indication and on each follow up visit the patient should be observed voiding if possible.

We have now observed 2 cases for 5 years since construction of the urethra. Fortunately for our purpose one of these was a child 3 years old at the time of repair and the other an adult 39 years old. The child has maintained a completely satisfactory urethral stream and growth of the penis (Fig. 9). No tendency to stricture or for the chordae to return has been observed. This would seem to indicate that the graft has maintained a normal growth rate. The adult has developed no stricture and according to both him and his wife, sexual function is normal (Fig. 10).

Both of these patients have been endocoped. The graft in each instance bears a close resemblance to urethral mucosa. There was no hair present. At the site of the anastomosis a circular ridge was observed through which the instruments passed easily.

SUMMARY

A method has been reported which is completely satisfactory for chordae correction.

1. We have used a one stage operation for urethral construction in 10 cases. This is a modification of the two stage Nové-Jossard principle which utilizes a free skin graft for urethral construction.

2. Our experience has shown that this is a more satisfactory procedure than the generally used operations dependent upon flaps.

3. The advantages of this procedure are: It can be done successfully in about 50 per cent of cases in one operation. The urethra has a normal exit in the glans penis. This permits a more normal type of urinary stream. The orifice ending at the frenulum as it does in many flap operations does not afford this ad-

vantage The graft from the upper arm tends to eliminate the disadvantage of hairgrowing in the urethra which has often been reported as a complication following construction of the urethra from penile or scrotal flaps. We have seen no definite strictures occur Following flap operations it is not uncommon to have complete failure or multiple fistulas form. The poorest result in this regard when the urethra is constructed with a free graft is a fistula at the anastomosis of the graft and the urethra. This can be successfully closed at a later time

We believe that these results show that it is not necessary to use a two stage procedure as originally described by Nové-Jossierand. Finally we believe that most important of all the method is applicable to preschool age children and can be used for any degree of hypospadias.

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CAUSALGIA

II The Signs and Symptoms with Particular Reference to Vasomotor Disturbances

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ALTHOUGH certain aspects of causalgia had been described previously it remained for Weir Mitchell and his associates (7) to give a full account of this condition in a remarkably vivid and comprehensive manner. According to them the syndrome was characterized by the following features. It occurred following partial injuries of peripheral nerves. Although a few patients stated that the pain began at the moment of injury the authors expressed some doubt that this occurrence ever actually took place. The pain commonly began some time after the injury and generally during the period of healing of the wound. It was always burning in nature although it was sometimes associated with other types of pain. The intensity of the pain varied from trivial to an indescribable torture. It was felt predominantly in the periphery of the affected hand or foot, especially in the palm of the hand, the palmar surface of the fingers, and the dorsum of the foot. The painful extremity was exquisitely hyperesthetic to touch. As the pain continued the patients began to show evidence of irritability, anxiousness and emotional instability. Exacerbation of the pain generally occurred from touching the extremity, dependency, jarring the body, noises and emotional excitement. The pain was usually made worse by dryness and heat and was eased somewhat by wetness of the part and often by cold. The affected hand or foot commonly showed nutritive changes: glossy skin, diminished or absent growth of hair, abnormally curved nails. The skin was generally a blotchy

red color and was always warmer than that of the corresponding hand or foot.

With the passage of time and the study of numerous additional cases the essential features of this original description were repeatedly confirmed. In certain details, however, variations were encountered. It was recognized, for example, that not in all patients was the skin warm and pink. In some it was cold and pale. As the sympathetic nervous system became implicated in the treatment and presumably in the physiopathological mechanism of causalgia these vasomotor alterations assumed added significance. It was commonly stated that patients with causalgia exhibited either vasoconstriction or vasodilatation in the affected hand or foot.

It is our purpose to discuss the signs and symptoms and particularly the vasomotor status in a group of 90 cases which we have recently had an opportunity to study. The same group of cases are analyzed (10) in reference to the rôle of sympathetic interruption in treatment. The study includes only those patients who were felt to be suffering from major causalgia although several were atypical in certain aspects. One of them, indeed, as we shall discuss subsequently may perhaps actually not represent a true case of causalgia. We have excluded cases of minor causalgia, amputation stump pain, phantom limb pain, Sudeck's atrophy and related posttraumatic vasomotor disorders and the burning pain of paraplegia.

THE NERVE INJURY

The upper extremity was affected in 49 cases, the lower in 41. In Table I the distribution of nerve lesions is tabulated. The incidence of nerve damage is based upon carefully performed neurological examination both before and after relief of causalgia. It must be

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emphasized that such examinations carried out before the pain has been eliminated are notoriously misleading the extent of nerve dysfunction often appearing greater than is actually the case. When the involved nerves were explored, the condition found at operation is taken into consideration.

It will be seen that in 34 of the 41 cases in involving the lower extremity the sciatic nerve was injured while in 5 of the 7 remaining cases either the peroneal or tibial nerve was damaged. When the sciatic nerve was injured the peroneal component was sometimes affected alone in other cases only the tibial component, and in still others both divisions. Altogether there was evidence of partial tibial paralysis in 27 cases while in 7 the tibial nerve was clinically completely paralyzed. Similarly the peroneal nerve was partially paralyzed in 16 instances while it appeared completely paralyzed clinically in 14.

In 14 cases the brachial plexus was injured. All cords of the plexus were traumatized in 9 instances the median and lateral cords in 4 and in 1 case only the origin of the ulnar nerve. In 11 cases the median radial and ulnar nerves were damaged and in the 24 remaining cases of causalgia of the upper extremity the median radial or ulnar nerve or various combinations of two of them. It has generally been stated that the median is a most commonly affected nerve in causalgia in the upper extremities as is the sciatic in causalgia of the lower extremities. Altogether the median nerve was partially paralyzed in 34 of our cases and apparently completely paralyzed in 5. Similarly the ulnar nerve was partially paralyzed in 29 and completely in 8.

In 11 instances the affected nerves of the causalgic extremity appeared clinically to be completely paralyzed. Seven were cases of sciatic injury in 1 the entire brachial plexus was paralyzed and in the 3 others the nerve involved was the saphenous the tibial and the median. When such lesions were explored neuromas in continuity were found and electrical stimulation failed to demonstrate any motor function. It must be emphasized however that we have no proof that a few intact sensory fibers may not have traversed the neuromatous mass. Our series contains no

TABLE I — DISTRIBUTION OF NERVE LESIONS IN CAUSALGIA

Nerves affected	No. of cases
Brachial plexus	14
Median radial and ulnar	11
Median	7
Median and ulnar	7
Median and radial	1
Radial	4
Ulnar	4
Radial and ulnar	1
Sciatic	33
Sciatic and saphenous	1
Saphenous	2
Peroneal	2
Tibial	3
Total	90

cases of complete paralysis in which widely divided and completely separated ends of the nerve were demonstrated at operation. All that can be said is that causalgia did occur in certain patients with apparently complete nerve lesions.

PAIN

In regard to the question which Mitchell, Moorehouse and Keen raised concerning the onset of pain at the moment the wound was incurred we found that our data were somewhat unreliable. A number of individuals stated that their pain began immediately but on more careful questioning it was always evident that their memory for such details during the first few hours or even days was often hazy. At any rate 50 said their pain began immediately, 23 from the first to the eighth day, 9 during the second or third weeks, 3 from 1 to 2 months and one, 4 months after injury. No data concerning onset of pain are available upon 4 cases.

The pain was described as burning in character by all save 4 patients. Only 40 of these 86 patients however had burning pain only. Pins and needles sensations were described by 9 patients, tingling by 17, stinging by 2. Two patients said they had knife like pains, 3 cutting, 8 shooting, 1 stabbing, 3 shock like, 1 sticking pain. Throbbing pain occurred in 7. Six had a sense of crushing, 2 of intense pressure, 2 of squeezing and 1 of mashing. Pulling, tearing, breaking, drawing, boring or buzzing sensations were complained of by another 6 individuals. Thirteen complained of a deep aching pain.

In contrast to the great frequency with which some relief of pain by wet applications was recorded in the original account of Mitchell and in other reports we found that numerous individuals had not experienced alleviation from anything at all indeed this was the case in 64 of the 90 patients. Twelve patients obtained slight or moderate relief from wet cold applications to the affected limb. They kept their hand or foot constantly wrapped in cool wet cloths. In all of them the painful hand or foot was warmer than the contralateral one. Three stated that cold weather gave some relief only in 1 was the extremity warmer than the other. Two individuals thought they obtained some alleviation either from local cooling or warming of the hand. Two thought warmth was of some help and 5 thought warm wet poultices eased the pain somewhat. In only 4 of these 7 patients was the temperature of the affected limb lower than that of the contralateral one. One patient said oiling of his hand gave a little relief and 1 found that he was helped by blowing upon his hand.

On the other hand all of the patients enumerated one or more factors which aggravated the pain. Almost without exception the pain was made more intense by use of the part and in every patient by touching or tapping the affected hand or foot. Most of them complained of increase in pain when the limb was made dependent. All of them guarded their injured limb with great care and all of those with injury of an upper limb kept the arm adducted, the forearm flexed and most of them supported the forearm with the other hand. They could be approached and examined only after urgent and gentle pleading and reassuring and even then examination was rendered unsatisfactory because of their great dread of having the extremity touched. In many patients exacerbation of the pain resulted from noises emotional excitement, and the slightest farring such as that induced by the closing of a door or the walking about of an individual in the examining room or even in the hallway outside. Unfortunately our records are incomplete in regard to this point in some instances. Such factors caused increase in pain rarely in the milder cases but

very commonly in the more severe ones. In addition to aggravation of pain from touching of the part 6 complained that continued pressure had a similar effect. One patient was made much worse by hunger. In 10 patients the pain was made worse by cold in 6 of them the affected hand or foot was cooler than the other. One who said moderate cold brought relief noted an increase in pain from intense cold. Three said either heat or cold intensified the pain. In 9 patients exacerbation from warmth was noted in 7 of them the hand or foot was warmer than the contralateral one. One patient who obtained some relief from wet warm applications was made worse by dry warmth. One said his pain was made more severe by wet weather 1 by dryness, and 1 by any wet applications.

It will be noted that 13 of the 15 patients who noted relief of pain from cold had relative increase in skin temperature of the affected limb and that a majority of those whose pain was helped by warmth had relative decrease in skin temperature of the injured extremity. Conversely a majority of those whose pain was aggravated by cold had relative vasoconstriction and of those made worse by warmth relative vasodilatation. It is perhaps significant however that there were exceptions.

The pain was localized in the hand or foot in all instances in a few it also extended to the forearm or leg. It was commonly limited to or was more intense in the distribution of the injured nerve but in numerous instances other parts of the hand or foot were also affected. As was true in the patients described by Mitchell and his associates the pain in the hand was generally felt in the palm and palmar surfaces of the fingers. In contrast to the experience however we found that the sole of the foot was very frequently the site of intense pain. Most of the patients described the pain as superficial but many also described it as deep.

In another article (10) we have analyzed the results of procaine sympathetic anesthesia in 83 patients and of permanent sympathetic interruption in 57. In all save 1 atypical case temporary complete or nearly complete alleviation of pain followed procaine anesthesia while in 21 patients a satisfactory permanent

TABLE II—DIGITAL SKIN TEMPERATURE STUDIES IN PATIENTS WITH CAUSALGIA IN WHOM THE AFFECTED AND CONTRALATERAL EXTREMITIES WERE ABOUT EQUAL IN TEMPERATURE

Case No.	Room temperature	Skin temperature of affected extremity			Skin temperature of contralateral extremity			Arterial occlusion	Subjective estimate of temperature of affected limb as compared with that of contralateral limb
		First digit	Third digit	Fifth digit	First digit	Third digit	Fifth digit		
	4	23	3	5 5	3 5	3	3	Yes	Colder
		20	20 5	3 5	20 5	3 5	3		Colder
3	7	3	5 5	3 5	3 5	3 5	3 5		
4	0	25 5	5 5	22	5	4	24		Colder
5	24 5	20 5	20	25 5	25 5	25 5	8 5		
6	24 5	3 5	23 5	3 5	3	3 5	3		
7	20	3	2	2 5	3	3	3	Yes	Colder
8	5 5	23 5	23 5	23 5	23	24	24		Colder
9	8 5	26	25 5	25 5	26	26	26	Yes	
	20	5	22	22 5	22 3	22	20 5	Yes	Colder
		22	22	22 5	22	22	3 5		
		24	24	24	24	4	3		Warmer
5	22	5	26	27 5	7	5	26		Colder
14	20	26	26	27 5	22	26 5	27		
5		5			5	5	5		Colder
16	24	3	3	24	24	3	3	Yes	
7		27 5	27 5	28	5	20	8		
8	5	22	20 5	5	3	3 5	3 5		Colder
9	5	24 5	3	3	26	3	1		

relief was brought about by one or more procaine blocks. In all save the one case in which little relief of pain followed sympathetic block, definite diminution in pain was achieved in the 57 cases treated by sympathectomy. In many the relief of pain was complete or nearly so.

VASOMOTOR STATUS

In all patients an effort was made to evaluate carefully the vasomotor status. An inquiry was made into the state of vasomotor tonus before the injury into the subjective sensation of warmth or coldness and of sensitivity of the hand or foot to cold during the present illness into any alterations of color or sweating into the presence of edema. It was not always possible to perform all the circulatory tests desired, often the patient's overwhelming fear of aggravation of pain could not be overcome sufficiently to obtain his permission or co-operation. For example, we

were commonly unable to obtain oscillometric studies and could never do such tests as reactive hyperemia. We were not equipped to do digital plethysmography or venous occlusion plethysmographic studies of blood flow in the limbs. Notes were made upon color, temperature, sweating, venous filling time when possible and edema. The effect of sympathetic procaine block upon pain, color and temperature was noted in 83 patients.

One patient gave a history of abnormally low vascular tonus, 11 of high vascular tonus and the remainder apparently had had normal vascular tonus before the injury. Since the onset of causalgia, 12 patients said the injured hand or foot was warmer than the contralateral one. Twenty-seven said the hand or foot was colder than the other. The other 51 patients thought there was no difference in temperature or in a few cases stated that the involved hand or foot was sometimes warmer and sometimes colder than the other.

TABLE III.—DIGITAL SKIN TEMPERATURE STUDIES IN PATIENTS WITH CAUSALGIA IN WHOM THE AFFECTED EXTREMITY WAS COOLER THAN THE CONTRALATERAL ONE

Case No.	Room temperature	Skin temperature of affected extremity			Skin temperature of contralateral extremity			Arterial occlusion	Subjective sensation of affected limb as compared to that of contralateral limb
		First digit	Third digit	Fifth digit	First digit	Third digit	Fifth digit		
		28.3		26	28	28	27		
	20	6						Yes	Colder
3	27	20	19	20	3	3	3	Yes	Colder
	20	23	3	2.5	25.5	35	35.5	Yes	Warmer
5	3	20.3	20.3	24.3	3.3	3.3	3		Warmer
6	24.5	29	28	27.5	20	29	29		
7	29.3	24	24	5	3.6	24	24		Colder
8		6.3	3	19	23	3.3	21		Warmer
		20.3	7	10	22.3	24	24		Colder
20	20.5	5	29.3	5		5.5	26.5	Yes	

Upon examination the affected hand or foot was pinker than its mate in 30 patients. Often this increased color was of a mottled spotty nature and in 8 instances was associated with a mild cyanotic tinge. The hand or foot was cyanotic in 29 cases and pallor was noted in 5 instances. In the rest there was no apparent difference in color between the injured and uninjured hands or feet. Our records contain notes concerning sweating in 57 cases. In 21 the affected hand or foot did not sweat in 5 sweating was diminished in 23 sweating was increased and in 8 patients there was no difference in sweating in the two hands or feet. In some patients the skin appeared to be relatively normal in texture. In almost half of the remaining cases it was dry and scaly and in the other half shiny thin and glossy. Stiffness of joints and abnormal curving of the nails were present in some especially those with glossy skin. In a number of cases the growth of hair was altered in most of them it was diminished in a few increased. The peripheral pulses were not significantly altered except in those patients in whom a major artery had been injured and ligated or occluded by thrombosis. In about 35 per cent of the patients venous filling time was about the same in the two hands or feet in about 25 per cent it was relatively increased in the affected limb while in the remainder it was decreased.

In 54 cases accurate skin temperature studies were made. In 19 (35 per cent) the digits of the affected hand or foot were about equal in temperature to those of the opposite extremity (Table II). Over half of the patients had the subjective feeling that the injured limb was colder than the other. In 10 (18.5 per cent) the causalgic hand or foot was distinctly colder (Table III). It is of interest that in 4 of the 10 patients a major arterial stem in the injured limb had been obliterated by traumatic thrombosis or had been ligated. Several of the patients had real sensitivity of the hand or foot to cold. Four of the 10 patients thought the affected hand was colder than normal, 3 that it was warmer and 3 thought that the two hands or feet were equal in temperature. In 25 (46.3 per cent) patients the digital skin temperature of the injured limb was distinctly higher than that of the other (Table IV). Nine of the 25 patients thought the hand or foot warmer than normal, 6 thought it colder than the contralateral one, and 10 noted no difference in temperature of the two hands or feet. Examination of the data recorded reveals that only in a few instances was the skin temperature in the range of maximal vasodilatation. In Table V skin temperature measurements in 13 of these patients before and after sympathectomy are listed. It will be seen that in nearly every case a distinct increase in warmth occurred after operation. It is obvious then

TABLE IV—DIGITAL SKIN TEMPERATURE STUDIES IN PATIENTS WITH CAUSALGIA IN WHOM THE AFFECTED EXTREMITY WAS WARMER THAN THE CONTRALATERAL ONE

Case No.	Room temperature	Skin temperature of affected extremity			Skin temperature of contralateral extremity			Arterial occlusion	Subjective estimate of temperature of affected limb as compared with that of contralateral limb
		First digit	Third digit	Fifth digit	First digit	Third digit	Fifth digit		
	70.5	3	20	24	5	20	0		Warmer
	5	20	21	3.5	27.5	28.5	28		Warmer
2	24	28	27	26.5	26	4	3		Colder
4	5	3.5	3	20.5	24	24.5	3.5		Warmer
5		29	29.5	29	5	24	3.5	Yes	Colder
6	5	3	21.5	22	28.5	28.5	20		Warmer
7		24.5	24	24.5	3	3.5	3		
8		27	27.5	20	27.5	26.5	4		
9		20	3	2.5	3	5	24		Warmer
	4.5	28.5	28	27	5.5	5	5.5		Colder
	20	26.5	27.5	27.5	24.5	5	26		Colder
		27	27.5	28	24.5	24.5	4.5		
5	29	22	22	22	3	20	29		Warmer
6	24	20	20	3			20.5		Warmer
8	26	3	3	22	20	20	20.5		
6		26.5	26	5	5	3.5	3		Warmer
7		26	27.5	28.5		5			Colder
8	3.5	29.5	27.5	3	7	27	27.5		Colder
9	5	20	20	20	2.5	22.5	26.5		
10	24	3	3	3	20	22	22		Warmer
	20.5	5	5	5	5	5	5		
	20.5	2.5	2	2	3	29	20		
3	4	3	3	3	29	26	5.5		
4		7	29	3	9	3.5	20		
5	5	25	27	22.5	1	2.5	—		

that vasodilatation in our cases was relative and not maximal.

In Table VI some oscillometric studies are tabulated. No cases are included in this table in which the circulation was altered by thrombosis ligation aneurysm or arteriovenous fistula of the main artery to the extremity. It is seen that in only 2 cases was the oscillometric reading distinctly greater in the affected limb. In half the cases the values were not significantly different in the two extremities while in 8 cases they were considerably less on the side of the injury. These findings are perhaps unexpected in view of the fact that in three-fourths of the patients the affected hand or foot was distinctly warmer than the other and

in only 1 was it colder. Indeed the finding of equal or reduced oscillometric readings in a limb in which some degree of skin vasodilatation exists as a consequence of peripheral nerve involvement might seem inexplicable. We have however often observed a marked increase in oscillometry after sympathectomy in extremities in which elevation of skin temperature had already existed as a result of somatic anesthesia. These observations suggest that interruption of sensory nerves may bring about surface vasodilatation without necessarily causing full dilatation of the larger arteries. It is entirely possible that on occasion certain irritative reflex phenomena may be present which tend actually to result in

TABLE V.—DIGITAL SKIN TEMPERATURE STUDIES OF THE AFFECTED LIMB BEFORE AND AFTER SYMPATHETOMY IN PATIENTS WHOSE INJURED EXTREMITY WAS WARMER THAN THE CONTRALATERAL ONE

Case N	Skin temperature before operation			Skin temperature after operation		
	Room temperature	First digit	Third digit	Room temperature	First digit	Third digit
1	20.5	5	79	24	5	79
2	24	38	27	26	38	27
3	21	21	21	21	21	21
4	21	20	20	20	20	20
5	21	21	21	21	21	21
6	20	20	20	20	20	20
7	20	20	20	20	20	20
8	20	20	20	20	20	20
9	20	20	20	20	20	20
10	20	20	20	20	20	20
11	20	20	20	20	20	20
12	20	20	20	20	20	20
13	20	20	20	20	20	20
14	20	20	20	20	20	20
15	20	20	20	20	20	20
16	20	20	20	20	20	20
17	20	20	20	20	20	20
18	20	20	20	20	20	20
19	20	20	20	20	20	20
20	20	20	20	20	20	20

relative constriction of the major arteries while at the same time anesthesia or hypesthesia from peripheral nerve injury results in relative skin vasodilatation.

OTHER OBSERVATIONS

There were associated vascular lesions in 23 patients. In 15 cases the main artery of the extremity had been injured and had either thrombosed or had required ligation. The brachial artery was so affected in 9 cases, the axillary in 3, the subclavian in 1, the femoral in 1, and the radial and ulnar in 1. In 8 patients an aneurysm or arteriovenous fistula had resulted and had either already been treated by some method requiring ligation of the affected artery or was so treated by us. In 1 patient there was an arteriovenous fistula of the brachial vessels and in 1 a fistula of the femoral vessels. Aneurysms involved the brachial artery in 2, the popliteal artery in 2, the axillary in 1, and the profunda femoral in 1 case. Atrophy and contractions tended to be more severe in the cases with arterial

TABLE VI.—OSCILLOMETRIC STUDIES IN PATIENTS WITH CAUSALGIA

Case N	Oscillometric readings in affected limb	Oscillometric readings in contralateral limb	Comparison of temperature of affected limb with the contralateral limb
1	7	5	Warmer
2	3.5	3	Warmer
3	3.5	3	Equal
4	3	3	Warmer
5	3	3	Warmer
6	3	3	Warmer
7	3	3	Warmer
8	3.5	3.5	Warmer
9	4.5	6	Warmer
10	8	8	Warmer
11	3	3	Colder
12	4.5	6.5	Warmer
13	3	3	Equal
14	3	3	Equal
15	4	4.5	Equal
16	3	3	Warmer
17	3	3.5	Warmer
18	3	3	Warmer
19	3.5	3.5	Warmer
20	7	3	Warmer

*No cases are included in which the circulation was shown by test bones, heat, aneurysm, or arteriovenous fistula of the main artery of the extremity. The oscillometric readings recorded were made in cases of involvement of the upper extremity and in the cases of involvement of the lower extremity.

occlusion than in those with good arterial circulation.

In 22 patients there were associated fractures. In 10 patients there was a fracture of the humerus and in 7 of the femur. In the remainder there were fractures of the pelvis in 1, the tibia in 1, the radius and ulna in 1, the humerus radius and ulna in 1. In most of the patients the fracture was infected and also ununited. These patients subsequently required further operative treatment. Not infrequently the bone grafting and the arthrolysis or neurolysis were carried out in a combined operation.

Osteoporosis was commonly present in the bones of the affected hand or foot but was not strikingly different from that found in similar cases of nerve injury and disuse not associated with causalgic pain.

DISCUSSION

Most of the observations made by Mitchell, Moorehouse and Keen concerning the signs and symptoms of causalgia have been substantiated in subsequent reports and are confirmed by the studies which we have made. Little has been added to their careful notes upon the pain its exacerbation and its effect upon the general physical and emotional state of the individual. In certain respects however there are discrepancies between their original findings and later observations. Their doubt that the pain ever commenced immediately following wounding is not borne out by the answers of our patients and the same was true in regard to a few of their own patients. Numerous patients said the pain began 'immediately' in our series and in those recently reported by others (9 11). One can of course question the reliability of memory for details during such a trying period. In all of the patients of Mitchell and his co-workers the pain was described as burning an observation so constant as to lead Mitchell subsequently to coin the term causalgia (6). In 86 of our 90 patients burning pain was present but 4 (4.4 per cent) did not describe any burning pain. About 10 per cent did not describe their pain as burning in Kirklin Chenoweth and Murphy's series. Rasmussen and Freedman found no burning in 45 of their 100 cases. They state that the clinical picture of these 45 patients was 'nearly identical' with that in the others. They do say however that Homans' cases of minor causalgia were similar to some of the 45. In our 4 cases without burning pain the symptomatology signs, and response to treatment were otherwise entirely similar to the rest. It would seem therefore that occasional individuals with true causalgia have no burning pain or describe it as pain of some other sort. With regard to the location of the pain subsequent observations have confirmed the original statements of Mitchell and his associates though specific observations such as its rarity on the sole of the foot, have not been substantiated. The transient partial relief of pain from wetting the part which they described has been commonly observed in other series of cases though generally in a smaller percentage of patients. Some of our

patients obtained such relief but many did not.

Mitchell Moorehouse, and Keen originally found causalgia only in cases of partial nerve injury. It has subsequently become apparent that causalgia may occur when the nerve damage is apparently complete (1 3 5 8). In 11 of our patients the nerve injury was clinically complete. When these lesions were explored neuromas in continuity were found and in none of our cases was the nerve found divided with widely separated ends. It is interesting that neurothraphy did not result in relief of pain except in 2 patients.

The glossy fingers tapering curving of the nails which occurred so commonly in the original account was present in a striking degree in only a small percentage of our patients. Such changes were more frequent in association with impaired vascular supply to the extremity.

The vasomotor status of the affected limb was often but not invariably altered. In about one-third there was no significant difference in temperature of the two hands or feet. In 18.5 per cent the causalgic hand showed evidence of vasoconstriction and in 46.3 per cent of vasodilatation. The vasoconstriction was intense in only a few however and the vasodilatation was rarely full. Some of the patients in whom the skin temperature was increased had no significant increase in oscillometric readings. The commonest alteration in color was a spotty redness of the part, or cyanosis of varying degree. Pallor was noted in a few of those with vasoconstriction. It was evident from our study that the patient's subjective estimate of the temperature of the limb was a poor index of the actual state.

When cases of vasoconstriction of causalgic limbs were first noted it became evident that the original finding of increased warmth was not a constant accompaniment of this syndrome. Most of those who have studied causalgia in recent years have reached the conclusion that this disorder is associated with some vasomotor alteration which may be manifested either as vasoconstriction or vasodilatation. It would appear from our studies that a considerable number of cases are associated with no significant vasomotor alteration and that

when such changes occur they are frequently not of extreme degree. Furthermore study of the vascular responses in numerous cases of peripheral nerve injury without causalgia reveals similar vasomotor changes to those noted in causalgic limbs. In such patients increased warmth of the injured hand or foot occurs very commonly and diminution in skin temperature in some. It would seem that the physiopathological explanation of the pain of causalgia must take into account the fact that the pain may occur in the presence of increased, decreased or relatively normal vasomotor tonus as well as the fact that altering the vascular tone by any means other than by sympathetic interruption results in no effect upon the pain in the majority of cases.

Kirklin, Chenoweth and Murphy have recently re-emphasized the constant feature of accentuation of pain in causalgia by certain disturbing features in the patient's environment. Our experience is in entire agreement. Donpe, Cullen and Chance have proposed relief of pain by sympathetic anesthesia as an essential characteristic of causalgia. In a survey of recently reported experiences with over 300 cases of causalgia, we can find nothing to suggest that any true case of causalgia has failed to respond to sympathetic block by a period of complete or nearly complete subsidence of pain. In our own experience such relief was obtained in all cases except one (10). This patient had a complete neuromatous involvement of the entire brachial plexus following an avulsion injury, thrombosis of the subclavian artery and fracture of the humerus. His pain was atypical in its wide distribution, the severe mashing aching burning and squeezing pain being felt throughout the hand forearm and the distal third of the arm. It was not affected by temperature but was worse with movement touching the part and with wet applications. Nothing brought amelioration. The circulation was precarious, and sympathectomy was performed largely for this reason; it afforded no more alleviation than the block. We have included this case in our survey particularly because it represents

the only real failure from sympathetic interruption. It is our feeling, however, that relief of pain by sympathetic block is an essential feature of true causalgia and in this respect the case should be excluded.

SUMMARY AND CONCLUSIONS

The signs and symptoms of causalgia are analyzed in a series of 90 cases. In the light of this study and available data in the literature it is concluded that the following features are an essential part of the clinical picture of major causalgia. It is characterized by constant spontaneous pain following injury of a peripheral nerve or nerves, generally but not invariably burning in character but also associated with other types of pain. The pain is most intense in and is usually limited to the distal portions of the extremity and particularly to the peripheral sensory distribution of the affected nerves. It is exacerbated by certain stimuli and is relieved completely or nearly so during adequate sympathetic or cocaine anesthesia. The associated nerve injury is generally incomplete but may be complete. The vasomotor status of the affected hand or foot may be relatively normal or may show evidence of varying degrees of vasodilatation or less often of vasoconstriction.

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DICUMAROL PROPHYLAXIS AGAINST VENOUS THROMBOSIS IN WOMEN UNDERGOING SURGERY

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ON January 31, 1943, the use of dicumarol was begun at the Free Hospital for Women with the purpose of preventing postoperative complications from intravenous thrombosis. The drug was administered to women undergoing major and vaginal plastic surgery. The major surgery comprised for the most part pelvic procedures but included a goodly number of operations on biliary, intestinal and urological parts of herniorrhaphies and radical mastectomies. Most patients receiving the drug were over 40 years of age. It was given to women under 40 with the following as indications: obesity, varicose veins, a history suggesting previous thrombosis and cardiovascular disease. During the 4 year period ending January 31, 1947, 2,353 patients were treated prophylactically with dicumarol. This paper is presented as a progress report.

Dosage schedule. On the assumption that intravenous thrombosis might begin during or just after surgery, dicumarol was given preoperatively for the first 3½ months of this study in doses of 200 to 400 milligrams during the 40 hours preceding operation. No difficulties were encountered in the matter of hemostasis during operations or as regards the development of postoperative hematomas. A higher than usual incidence of postoperative thrombosis in leg veins ensued, the complication occurring 6 to 15 days after the taking of the drug without serious consequence. The impression was gathered that when the effect of dicumarol disappears, the blood of some women seems to acquire a greater tendency to clot intravenously. That a few thrombotic complications have since developed in dicumarol treated patients after their discharge from the hospital strengthens this impression.

Because of this early experience a change to postoperative administration of the drug was made.

For the next 22 months dicumarol was prescribed 30 to 48 hours after operation and again 5 days later. A third dose was administered after an additional 5 days if the patient was still in bed. The 5 day interval was chosen on the basis of studies of prothrombin times (*vide infra*). The first 2 doses were arbitrarily set at 200 milligrams for patients weighing more, and 100 milligrams for those weighing less than 60 kilograms. The third dose was 100 milligrams. The schedule was interrupted upon the occurrence of a hemorrhagic complication or if the prothrombin time was found to be 70 seconds or over 4 or 5 days after the preceding dose.

Because of a small series of secondary vaginal hemorrhages following plastic procedures late in the winter of 1945 and associated with unusually prolonged prothrombin times these doses were all reduced to 50 milligrams. The death of a patient from pulmonary embolism early in May, 1945, 2 days after receiving her second 50 milligrams of the drug brought about a return to 100 milligram and 200 milligram doses, the latter however being much less frequently prescribed. Furthermore since patients were getting out of bed sooner during 1945 and 1946 the third dose was only occasionally given. Although the majority of patients treated between May, 1945 and February, 1947 have taken 100 milligrams 28 to 40 hours after surgery followed by a similar amount 5 days later, a fair number of patients have received these amounts the night before operation and 5 days later. In these no greater tendency to bleed during operation has been noted.

Prothrombin time. The dosage schedule employed in this clinical trial was planned with the purpose of prolonging the prothrombin

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TABLE I—INCIDENCE OF POSTOPERATIVE THROMBOTIC COMPLICATIONS

Number of patients	Number of thromboses	Incidence	Number of nonfatal emboli	Incidence	Number of fatal emboli	Incidence
1. 1917-1934, incl—1,458 ward patients					23	1.56
2. 1937-1939, incl—6,54 private patients						1.20
3. 1937-Jan. 30, 1943, incl—1,466 ward patients	38	90	28	14.15		6.56
4. 1940-Jan. 30, 1943 incl—1,855 private patients	9	95	8	26.1		9.04
Totals before dicumarol	37	90	31	43.2	66	28.4
5. Jan. 1, 1943-Jan. 30, 1947 incl—1,000 ward patients, 50 received dicumarol	26	30	16	36.30	3	18.75
6. Jan. 31, 1943-Jan. 30, 1947 incl—1,797 private patients, 97 received dicumarol	6	3	6	6.3		3.99
Totals during dicumarol	42	33	22	33		30.77
7. Jan. 31, 1943-Jan. 30, 1947 incl—total of 5, 53 received dicumarol		33		33		31.7

*The number of thromboses includes those who developed embolism, both nonfatal and fatal.

time in the majority of patients at the same time avoiding hemorrhagic complications and compared with the amounts of dicumarol used by others in the actual treatment of thrombosis was conservative. Because of the limitation of technical help imposed by exigencies of war time and to avoid the discomfort of repeated venipuncture the intention was to carry out this study with a minimum of prothrombin determinations. Early in the series sufficient determinations were made to show that doses of 100 milligrams of dicumarol cause the prothrombin time to be prolonged significantly in most patients by the second day after ingestion this effect lasting 2 to 5 days. Prothrombin times were determined frequently during the early months of this investigation and then sporadically until the late summer of 1944 chiefly in those having thrombosis or hemorrhage. Subsequently more frequent determinations were made and it gradually became a routine to have the prothrombin time performed before the second dose of dicumarol was prescribed. Failure to perform the test daily on all patients resulted in too low dosage for those who developed thrombosis and in failure to detect the few who because of apparent sensitivity to the drug developed unusual or aggravated hemorrhagic complications. It has also become routine to delay the second dose of dicumarol for 3 days if the prothrombin time is less than 35 per cent of normal or under the same circumstances to

omit the second dose entirely if the patient is ambulatory.

Results and comments. In Table I the incidence of postoperative thrombotic complications among ward patients is compared with that among private patients both before and during the dicumarol era. The study covers 41,001 patients operated upon 31,950 before and 9,051 during the 4 year period of prophylactic dicumarol administration. About 38 per cent of the operations performed at this hospital are major; about 35 per cent consist of major pelvic surgery and about 30 per cent are hysterectomies. For example of the 1,797 patients operated upon in 1946 885 underwent major surgery and of these 716 had hysterectomies. The number of thromboses given in the table includes those who developed embolism, both nonfatal and fatal. Under the heading of thromboses are included cases of superficial and deep phlebitis of one or both lower extremities as well as pelvic phlebitis. By the term phlebitis both phlebothrombosis and thrombophlebitis are meant.

Seven of the thromboses listed in Sections 5 and 7 of Table I occurred in patients who had received dicumarol before operation only. As stated under Dosage schedule it is our impression that these patients, most of whom were not ambulatory when the effect of the preoperative dicumarol had worn off had become more prone to the development of thrombosis, perhaps as a result of an over

production of clotting factors in the response to the drug. None developed pulmonary complications.

Since 1930 various means have been employed in an effort to reduce postoperative thrombosis at this hospital viz raising the foot or the head of the bed for one to 4 days after operation giving thyroid extract encouraging activity in bed and maintaining a better fluid balance. Yet thrombotic complications were not reduced. In fact in 1942 there were 36 cases of thrombosis the highest incidence in years. Perhaps the decreased incidence of thrombosis and pulmonary complications since 1942 (Table I, Sections 5 and 6) may be laid to even greater awareness of the medical and nursing staffs toward measures considered possibly effective in the prevention of thrombosis. The use of abdominal binders was discontinued. Postoperative distention has been more actively combated by gastric and intestinal intubation. Fluids and vitamins B and C have been more freely given parenterally. Deep breathing and leg exercises have been encouraged but not enforced. The more general employment of antibiotics by preventing or ameliorating major and minor sepsis has undoubtedly had some influence against thrombosis. Finally during 1945 and 1946 patients have been getting out of bed earlier between the third and eighth postoperative day but real early rising has only occasionally been instituted. Thus the improvements shown in Table I may not be attributed unequivocally to the use of dicumarol. On the other hand they seem sufficiently impressive to warrant the conclusion that dicumarol was a factor in their achievement.

That there were no fatalities from pulmonary embolism among the private patients operated on between January 31 1943 and January 31 1947 (Table I Section 6) although only 197 (selected cases of the senior author's) had dicumarol, statistically appears to weaken any proposition that the prophylactic use of the drug in ward patients was effective. The impression prevails among many clinical investigators however that postoperative thrombotic complications occur more often in ward than in private patients. This

TABLE II—COMPLICATIONS AND DICUMAROL

Type	943-1944 No. cases	945-1946 No. cases	Total
Hematemesis			
Hematuria	8		
Vaginal hemorrhage	14	6	20
Hematemesis and vaginal hemorrhage			
Subarachnoid bleeding			
Total	0	7	26

Impression is supported by the figures in Table I except as regards nonpulmonary embolism which occurred often in private than in ward patients before and during the dicumarol study notable that there was no striking decrease in the incidence of nonfatal embolism in patients such as took place in the ward patients during the time dicumarol was prescribed (Section 6 Table I). The 61 patients with nonfatal embolism were fully treated either by heparin and interruption of the femoral veins these measures in all probability being effective in preventing at least 1 or 2 fatalities.

The 1 fatality from embolism among receiving dicumarol prophylactically (Section 7 Table I) occurred 2 days after the two 50 milligram doses of the drug which retrospect were too conservative. One patient in this group who developed embolism was refractive her prothrombin time being normal 3 days after a 100 mg dose.

Complications from dicumarol. The complications were hemorrhagic. No side effects were observed. In Table II listed the hemorrhagic complications attributed at least in part to dicumarol because the unusually prolonged prothrombin time determined in these cases. The vaginal hemorrhages occurred in patients who had had pelvic operations or total hysterectomies or both. Although the drug is believed to have prevented vaginal hemorrhage in the cases listed we would point out that the incidence of operative vaginal hemorrhage during years before the dicumarol experiment was

same as that both in the dicumarol group itself and in all patients operated on between January 31 1943 and January 31 1947. The reduction of hemorrhagic complication in 1945 and 1946 however when 200 milligram amounts of dicumarol were much less often prescribed and when the giving of the second dose was contingent upon a prothrombin time not less than around 40 per cent of normal is noteworthy. Hemorrhage associated with an unusually prolonged prothrombin time has been satisfactorily treated by menadione bisulphate in 40 to 64 milligram amounts administered parenterally and repeatedly and fresh whole blood transfusion—along with resuture when of vaginal origin.

The patient who developed a subarachnoid hemorrhage died. The following is an abstract of her record.

Mrs. P. MacL. (Hospital No. 33473) aged 46 years, weight 127 pounds was admitted on August 10, 1944. On preoperative examination her blood pressure was 130/80 and the only abnormal cardiovascular findings were a soft apical systolic murmur and moderate varicosities of the veins of both legs. On August 13 1944, complete hysterectomy and bilateral salpingo-oophorectomy were performed for a 6 inch right ovarian cyst. She received 100 milligrams of dicumarol 34 hours after operation and again 5 days later. Prothrombin time was not performed. Convalescence was uncomplicated and she was discharged on August 24. At 6 o'clock the fol-

lowing morning after returning to bed from the bathroom she experienced severe occipitofrontal headache accompanied by tingling sensations in fingers and toes. There followed intermittent vomiting.

She was readmitted on August 25. Nothing abnormal was found on general physical and neurological examination except for stiffness of the neck. No localizing signs were elicited. Lumbar puncture released amber colored fluid under pressure. By August 31 there was much less headache and vomiting had ceased. The prothrombin determination however on that day 13 days after the last ingestion of dicumarol, was 36 per cent of normal indicating idiosyncrasy to the drug. The ingestion of 7 grams of acetylsalicylic acid during the previous 6 days probably had contributed to the prolonged prothrombin time. She was transferred to the Neurological Service of the Massachusetts General Hospital. On September 5 her condition was reported to be good, but 9 days later death was caused by a second subarachnoid hemorrhage. It would seem that if dicumarol had played a part in her demise death would have occurred at the time of the first hemorrhage.

CONCLUSION

The use of dicumarol in 2,353 selected patients out of a total of 9,051 operated upon during a 4 year period appears to have contributed to a considerable reduction of the incidence of postoperative thrombotic complications without in itself causing a distressing amount of trouble.

At autopsy multiple small aneurysms of the circle of Willis were revealed along with organizing and recent hemorrhage.

CARTILAGINOUS TUMORS OF THE HAND

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CARTILAGINOUS tumors of the hand grow in on or in close association with the bones of the hand and wrist. These tumors are clinically important because to a great extent they occur on or in two of the most important organs the hands. In the hand these tumors (1) interfere with function (2) are a source of potential malignancy and (3) are unsightly for cosmetic reasons (Fig 1).

It was found on reviewing the literature that all too often cartilaginous tumors are lumped together under the heading osteochondroma and the suffix sarcoma added to denote malignancy. It was discovered that it is correct on the basis of pathology to divide these tumors into two types the enchondroma or chondroma and the ecchondroma.

HISTORICAL DATA

As early as the time of Virchow the distinction between enchondromas and ecchondromas had been made and mentioned in the German literature.

Virchow stated that an enchondroma was an enlargement of a cartilaginous rest in the bone marrow and in other sites where cartilage was not normally found. He called an ecchondroma a perichondroma and stated that these cartilaginous tumors occurred at the edges of bone were usually located near the epiphyses of long bones and came from an overgrowth of permanent cartilage.

Enchondroma Geschickter (10-14) and many others have been of the opinion that these tumors are the result of cartilage rests which represent supernumerary articular cartilages. This opinion is supported by the fact that these tumors occur in a location where many small joints develop such as the hands

feet and vertebrae. These cartilage rests or islands form the central chondromas. Virchow also stated much this same hypothesis and it is supported in the literature by Bell (2) who said that chondromas may arise from temporary osseous cartilage and from fetal cartilaginous rests. Bell (1, 3) also stated that they may arise from some other connective tissue by metaplasia. Goddu, Raisch, Boyd, Ewing and Gatewood supported the cartilage rest hypothesis of origin or that of a primitive mesenchymal tissue misplacement which is essentially the same thing. Meyerding wrote that these tumors arise from a transition of connective tissue cells in sites where cartilage is not normally found. Bunnell said that these tumors are congenital are found almost always in the hand usually occur singly and represent potential articular cartilages in the phalanges. Haas simply stated that an ecchondroma arises from a site where cartilage does not normally occur. Mason reported that these tumors have never been found in a carpal bone.

Ecchondroma Geschickter (11, 12, 14) stated that the bones and joints begin their development as primitive mesenchymal prechondral connective tissue. This tissue has the ability to develop into bone cartilage synovia perosteum and so forth. It is very undifferentiated tissue. By mucoid degeneration this tissue undergoes modeling then by differentiation cartilage is formed and finally bone. The ends of the tendons which are destined to attach to the ends of the long bones develop and approach their site of insertion into the primitive bone. The precartilage of the end of the tendon and the bony outgrowth from the precartilaginous bone approach each other and unite. If junction occurs normally both are surrounded by perosteum and no abnormality develops. However if there is any malunion or irregularity of union in which the bony outgrowth fails to blend with the end

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Abridgment of thesis submitted by D. Shellito to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of M. S. in Surgery.



Fig Enchondromas of the hand

of the tendon and does not become enveloped in periosteum an enchondroma will develop.

In 1930 Dean Lewis said that although the tendon developed from fibrous connective tissue the tendon insertion developed from pre-cartilaginous connective tissue.

Tumors of the tendon sheath. Tumors of the tendon sheaths were first reported by Von Chassagnac in 1852 and have long been considered rarities. The least common of all of these tumors according to Buxton is the chondroma. In 1923 he wrote that the chondroma could occur within the tendon sheath and when such was the case usually was associated with trauma. Some authors have considered that these intrasheath chondromas come from the synovia while according to others they arise from tissue of mesenchymal origin at the edge of the synovia of the joint or sheath.

Geschickter (14) has said that the enchondroma is, by far the most common of the cartilaginous tumors of the tendon sheath.

King stated that chondromas developed from cells of the synovial membrane of the tendon sheaths which cells were capable of forming cartilage when exposed to an adequate stimulus. Hence he felt that the chondroma was the result of metaplasia of the cells of the synovial tendon sheath.

The most accepted hypothesis at this time seems to be that of Niosi and Castiglioni who stated that the primitive reticuloendothelial cell, normally present in the synovial membrane could develop into cartilage by metaplasia in response to an adequate stimulus. This stimulus usually is thought to be multiple rather than single and to consist in repeated slight trauma.

MATERIALS AND METHODS

In this study the operative specimens of tumors of the hand at the Mayo Clinic from 1908 to 1945 were sectioned and studied and all the case histories were reviewed.

Only those tumors from which a pathologic specimen suitable for section was available were included in the series. If a specimen was not available and pathologic study was not possible the case was dropped from the series.

Each case was studied clinically and pathologically. The case was reviewed to determine age, sex, presence of pain, trauma, pathologic fracture, whether the tumor was single or multiple and its location in the hand.

Hyaline cartilage was used as a normal for comparison. Variations from this normal as found in the tumors, were graded in an ascending scale of 1 to 4. The tumors were studied microscopically for vascularity, myxomatous

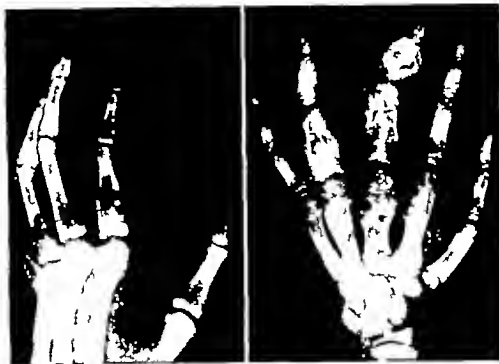


Fig. 2 a, left, Pathologic fracture b, enchondromas of the hand.

change malignant change cellularity calcification of cartilage and recurrence

Roentgenograms in each case were studied and the diagnosis of the roentgenologist was compared with that of the pathologist

The work was confined to tumors of the hand and the carpal bones of the wrist

Forty two cases of cartilaginous tumor of the hand comprise this series Of the forty two 30 were cases of enchondroma (71.43 per cent) and 12 of echondroma (28.57 per cent) One instance of enchondroma or chondrosarcoma was malignant

CLINICAL FINDINGS

Enchondroma Enchondroma was found in the small bones of the phalanges in 25 cases and in the metacarpal bones in 15 cases. Hence these tumors were more common in the phalanges.

A history of pain was elicited in 26.6 per cent of the 30 cases of enchondroma and always was associated with pathologic fracture (Fig. 2a) Pathologic fracture occurred in the same cases in which a history of pain was noted The remainder of the patients came to the surgeon because of swelling of the finger or metacarpal bone (Fig. 2b) but not because of pain

The ratio of males to females was 17:13 and the average age at the time of operation was 35 years

Of the enchondromas it was found that 5 were multiple and 25 were single tumors

Tumors of the tendon sheath Two cases of tumors of the tendon sheath were found in the 42 cases of the series Both of them were enchondromas One of these tumors was a single enchondroma but the other was more interesting in that there were 5 separate chondromas in the tendon sheath (Fig. 3a)

In both cases a preceding history of trauma was noted Both patients were men and the site in each instance was a flexor tendon sheath

Echondroma The ratio of males to females was 1:1 and the average age was 33.6 years

These tumors occurred with almost equal incidence on the phalanges and metacarpals They arose at the insertion of a tendon usually on the proximal side and caused a lump or protuberance of the bone

It was found that trauma was associated in 4 cases but in each instance after the tumor had arisen After the swelling had developed the patient bumped the enlargement and realized that a tumor was present In the same 4 cases a history of pain associated with the



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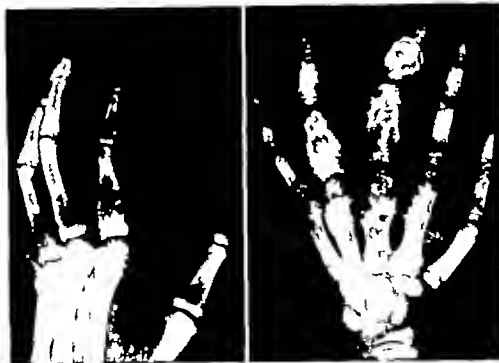


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Fig. 3 a, Enchondroma of the tendon sheath which occurred way from the site of tendon insertion. Evidence of calcium deposition can be seen. b Enchondroma showing

log increased vascularity. c, Enchondroma cut at the base of the cartilaginous cap, showing the junction of the bone and cartilage.

trauma had been given and the patients in these cases were the only ones in cases of enchondroma that did mention pain. No pathologic fractures were encountered.

In 2 of the cases more than one tumor had developed and in 10 single lesions.

ROENTGENOGRAPHIC OBSERVATIONS

Enchondroma. The roentgenographic picture of these tumors caused the roentgenologist to suspect the presence of chondroma in 50 per cent of the cases (Fig. 2b).

The typical picture was that of the so-called bone cyst which was seen as a small round area of decreased density in the center of the bone. The cortex usually was expanded and thinner than it normally is. The outline was round and regular and appeared in the center of the shaft.

Enchondroma. In contrast the roentgenologist was able to make the diagnosis in almost all of the cases of enchondroma. The lesion in this case appears at the periphery and one end of the bone. The bony elements of the base of the enchondroma show plainly as an elevation of bony structure.

PATHOLOGY

At the Mayo Clinic in a 10 year period from 1935 to 1945 the relationship of enchondroma to enchondroma in all sites and in all bones of the body was 64.13 per cent enchondroma and

35.87 per cent enchondroma. However when the cartilaginous tumors of the hand alone were considered, it was found that the relationship was reversed and that enchondroma occurred in only 28.57 per cent and enchondroma occurred in 71.43 per cent. Hence, the enchondroma occurs much more commonly in the hand and much less commonly in the foot, than in any other location in the body.

Enchondroma. These tumors occur most frequently in patients between the ages of 20 and 30 years.

The vascularity of these tumors was graded from 1 to 4 with normal hyaline cartilage used as a control. An average of 2 plus was found. Thus these tumors have an increased blood supply (Fig. 3b).

The degeneration of an enchondroma is interesting and was investigated thoroughly. The literature varies widely on this subject and lists many different kinds of degeneration, such as fatty hyaline, calcium and fibrous. In this series myxomatous tissue was considered as a degenerative phase of a hyaline enchondroma and was found in 53 per cent of all the enchondromas. This tissue did not occur regularly in just one area of the tumor such as central or peripheral but was located at random and varied from tumor to tumor. The extent of this degeneration was graded from 1 to 4 and an average of 2 was obtained.

No other type of degeneration occurred except in 6 cases in which deposits of calcium were seen. This calcium *not* in the form of bone was usually small in amount and deposition occurred in conjunction with myxomatous degeneration. There was no site of predilection.

Ecchondroma These tumors occur most frequently in patients from 10 to 25 years of age. The tumors are bony outgrowths surmounted by a cartilaginous cap (Figs. 3c and 4).

The microscopic picture of an ecchondroma is varied in accordance with the site of section. If the section is taken across the bony base it will apparently be composed entirely of bone and if the section is taken high on the cartilaginous cap the tumor will appear to be composed entirely of hyaline cartilage (Fig. 3c).

The blood supply of an exostosis osteochondroma or enchondroma comes from the bone marrow both the bony element and the cartilage being supplied from this same source. Evidence of abnormally increased blood supply to the ecchondroma was not found.

Degeneration was observed rarely and when evidence of it was found it was very slight and took the form of a mild myxomatous change in the cartilage elements. The cartilage itself was not divided into many lobes or lobules as it is in an enchondroma and the tumor did not grow from many sites or sources as does an enchondroma.

Malignancy Malignant cartilaginous tumors may arise from either an ecchondroma or an enchondroma. According to the reported cases in the literature it is more common for them to arise from an enchondroma than from an ecchondroma.

It always has been stated that a chondroma will recur if some enchondroma cells are misplaced, allowed to transplant or left *in situ*. This is not true of ecchondroma. The fact that a chondroma recurs after one removal does not necessarily mean that it is malignant, although malignancy is difficult to determine in these cases. The criteria for malignancy in an enchondroma are increased cellularity and the presence of an occasional mitotic figure. Mitotic figures may be difficult to find in what would otherwise be a benign enchondroma.



Fig. 4. Gross appearance of an ecchondroma.

In the entire series 5 tumors recurred. One recurrence was that of an ecchondroma and was due to slow growth of remnants of the cartilage cap. The other 4 recurrences were of enchondromas, only 1 of which was considered malignant. Evidence of metastasis was not found.

The 1 malignant tumor was a chondromyxosarcoma (incidence 2.62 per cent in our series). The patient was operated on 5 times at 2 year intervals for a recurring benign chondroma and it was not until the fifth operation that a diagnosis of low-grade malignancy could be made.

TREATMENT

In all cases of enchondroma treatment was conservative. The tumor tissue was curetted leaving as much of the bony shell as possible. Bone grafts were used where needed. Also in cases of ecchondroma treatment was conservative and consisted of removal of the protuberance and as much of the bony base as was necessary to restore the normal continuity of the bone.

COMMENT

The cartilaginous tumors as a group have been called osteochondromas and this has created some misunderstanding. An ecchondroma can also be called an exostosis or an osteochondroma and is found near the ends of both the long and the short long bones at or near the site of a tendon insertion. An enchondroma can also be called a chondroma and occurs most commonly in the short bones of the hands and the feet although it can also

occur in any bone which has had an embryonic cartilaginous origin. The membrane bones of the face and skull are not the sites of chondromas. The chondroma occurs centrally in bone and grows from several centers expanding the cortex. It is silent until it reaches a size large enough to be recognized as a swelling or tumor of the hand. It often calls attention to itself by a pathologic fracture. The roentgenologist commonly makes a diagnosis of simple central bone cyst.

The enchondroma or osteochondroma arises from the cortex of the bone and has a bony base and a cartilaginous cap.

Enchondroma. The ideas concerning origin of these tumors are many and varied. The one which has best withstood the test of time is that of primitive cartilage rests. It has been noted that chondromas occur with the greatest frequency in regions where there are a great many small joints and bones. It is known that bone which is not membranous is first preceded by primitive connective tissue or mesenchyma. This connective tissue differentiates into areas or strands from which bone is formed by differentiation. Also from this same tissue and from primitive cell tissue comes the synovia of the joint and the insertion of the end of tendons and the marrow and cortex of the bone. The bone itself is formed first by differentiation into primitive cartilage and then replacement by the osteoclasts and osteoblasts to form the actual bone.

The synovia of joints and the cartilaginous bony ends which articulate each with the other are also formed from this same tissue. The articular cavities are formed by degeneration of this primitive connective tissue and its subsequent absorption.

Thus it is thought that at the time of replacement of the primitive cartilage in order to form bone or at the time of the absorption of the primitive connective tissue in order that the actual joints and joint spaces may result, some of this early mesenchymal cartilaginous tissue is caught or left behind and occurs as a rest in the end-result the adult bone. These rests still retain their primitive quality and are able to form cartilage although they do not lie where cartilage normally should be. Therefore it is thought perhaps in response to

trauma (occurs in 60 per cent of cases) or some other stimulus that these cells begin to differentiate and grow in the adult bone and a central chondroma results in a site where cartilage should not be.

According to some authors the myxomatous degeneration of an enchondroma is further evidence of differentiation and that it would be followed by the formation of bone so that an echondroma would result. This did not seem to be the case in this series as no early bone was found in a true enchondroma regardless of the amount of the myxomatous change. Hence except for the fact that the echondroma and the enchondroma basically came from the same primitive connective tissue cells for their formation as also does adult bone cartilage and other mesenchymal structures, they cannot be said to be associated one with the other in development. One does not develop from the other nor is one a stage in the formation of the other.

Echondroma. The echondroma occurs near the ends of the long bones and the ends of the short long bones. It does not often occur in the membrane bones of the face and skull. It does not occur in the hand with greater frequency than in any other location in the body.

Many different hypotheses of origin have been formulated but the basic one of Geschickter (9-11) seems the most plausible. He stated that the primitive mesenchymal connective tissue first forms a tissue layer which differentiates into cartilage which is then replaced by bone. The end of the tendon is also composed of this primitive connective tissue which likewise has the ability to differentiate into cartilage or bone. The epiphyseal end of the bone puts out a protuberance which is destined to unite with the primitive connective tissue of the end of the tendon. If this union is effected smoothly and the junction is adequate it is covered with periosteum from the bony cortex and no tumor results. However if this junction of the tendon and bone is not good and is irregular or misplaced the periosteum from the cortex of the bone covers only the bony protuberance which was to be the site of insertion of the tendon and does not blend and cover the precartilaginous end of the tendon. The cells of this misplaced precarti-

lagnous end of the tendon are still undifferentiated connective tissue cells and when they begin growth in response to some stimulus or perhaps no stimulus an enchondroma or osteochondroma results. This is an attempt on the part of these cells to form bone and takes the form of an articular end of bone. As a result the enchondroma has a bony base which at the apex blends with primitive cartilage. The bony base is surmounted by the cartilaginous cap which in the outer layers is adult hyaline cartilage.

Therefore the enchondroma is found at the ends of the long bones and the short long bones usually on the proximal side of the insertion of a tendon and not on the bones of the skull and the face, such bones being membranous in origin. The enchondroma is always peripheral (the perichondroma of Virchow) and never central. No correlation of enchondroma with such diseases as syphilis, tuberculosis or rickets was found in this series.

Tumors of the tendon sheath. Concerning the origin it seems reasonable that an enchondroma could occur in a tendon sheath at the site of insertion of the tendon and arise from the primitive mesenchymal cells of connective tissue. It also seems reasonable that an enchondroma could occur in the tendon sheath far from the insertion of the tendon. In 2 cases in the literature this occurred. In such cases it is thought that the cartilage cells arise from those of primitive synovial membrane in response to an adequate stimulus.

The total number of reported cases of tumors of the cartilaginous tendon sheath still remains small and variable. One author (22) stated 12 as the number in the literature and another 40 (17-19). Hence it is difficult to say which occurs more commonly, the enchondroma or the perichondroma. The exact nature of origin of these tumors is in doubt, probably because of the small number of cases on record. It is probable that these tumors, both enchondroma and perichondroma, arise from a primitive mesenchymal connective tissue cell which is associated with the synovia of the tendon sheath and the joint, and that they are capable of differentiating into either cartilage or cartilaginous bone in response to an adequate stimulus.

SUMMARY AND CONCLUSIONS

Cartilaginous tumors of the hand on the basis of pathology may be divided into two types: enchondroma and perichondroma. The synonym for enchondroma is chondroma. Perichondroma is called perichondroma, osteochondroma, and exostosis. (The word osteochondroma is restricted to the enchondroma.)

The fact that the entire group of cartilaginous tumors is commonly called osteochondroma has led both in the past and in the present to a great deal of confusion. It is better to use the terms enchondroma and perichondroma.

Distinction between the two cannot be made with slide and microscope alone.

An enchondroma is usually a small cartilaginous tumor located centrally in the bone shaft, growing from many centers and expanding in all directions. Rate of incidence of pathologic fracture in our series was 26.6 per cent. The enchondroma occurs much more often in the hand than does the perichondroma (3:1). These tumors, in comparison to normal hyaline cartilage, show increased vascularity, calcium deposition, and myxomatous degeneration.

Two tumors of the tendon sheaths were found, both of which were perichondromas. In one of these cases multiple perichondromas of the sheath had developed, and this is good evidence that an enchondroma can occur in the tendon sheath away from the site of tendon insertion.

The perichondromas occur peripherally in bone near the end of the shaft and have a bony base and cartilaginous cap.

Either type of tumor may be malignant, in which case it is usually a sarcoma. In this series 2 per cent were malignant. Both types are prone to recur, although recurrence does not mean malignancy, unless a mitotic figure can be found.

The treatment in both types is conservative operation.

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STUDIES ON VAGOTOMY IN THE TREATMENT OF PEPTIC ULCER

I The Use of Insulin in Testing for Completeness of Vagotomy

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THE relationship of the vagus nerves to normal and pathologic gastric physiology has been studied for many years. The cephalic phase of gastric secretion mediated entirely by the vagi was first demonstrated by Pavlov in 1890 (1, 2) and later confirmed by Ivy (3) and Farrell (4). The copious work in this field has been summarized by review articles (5, 14).

In 1912 vagotomy was first advocated in man as treatment for gastric crises in tabes by Exner and Schwarzmänn (15). In 1915 Exner and Schwarzmänn reviewed the literature and presented 14 cases of subdiaphragmatic vagotomy (16). In patients a simultaneous gastroenterostomy was performed for pylorospasm, decreased gastric peristalsis and atonia. The variability of the anatomy of the vagus nerves was discussed.

Vagotomy as a treatment for peptic ulcer was advocated by Stierlin (17) in 1920. Latarjet (18), Bricher (19) and Schiassi (20) in 1925 and has since been investigated in both experimental animals and man by many others (8, 10, 11, 14, 21, 34). It has often been demonstrated experimentally that incomplete vagus section produces no significant change in gastric activity (8, 12, 29, 36). Weinstein's 2 attempts at complete vagotomy reported in 1944 (37) were unsuccessful and led him to conclude that complete vagotomy in man is difficult to achieve. Prior to 1943 there are no reports of patients having definite complete vagotomy. Dragstedt's first report of total vagotomy in 1943 (38) and other papers which followed (39-53, 102) have caused renewed interest in the problem. It is

clear from both the long clinical experience with partial vagotomy and the experimental evidence that incomplete vagotomy is of little if any value in the treatment of peptic ulcer. It is therefore of great importance in the evaluation of vagotomy to have a method for testing vagus function following attempted complete vagus section. Two such methods are available: sham feeding (36, 41) and the use of insulin. This paper is concerned primarily with the insulin test of vagus action on the stomach.

The effect of insulin hypoglycemia on the stomach has been thoroughly studied. The increase in gastric motility following insulin hypoglycemia was first demonstrated by Bulato and Carlson (54) in 1924 and has since been investigated by many others (55, 69). The effect of insulin on gastric secretion was originally thought to be inhibitory by Collazo (70) but no inhibitory effect was noted by Ivy (71) and Wrendensky (72). The stimulating effect of insulin hypoglycemia on gastric acidity was first noted by Detre and Silvo (73) in 1925 and later confirmed by others (74-89). The mechanism of action was considered a central vagal effect by Quigley (58), Okada (81), Boldyreff (85), Mulinos (66) and Bahkin (12). The abolition of this stimulatory effect by vagotomy was described by Okada (81), LaBarre (83), Bahkin (12) and Jemerin (36). Thus insulin provokes increased gastric motility and secretion by hypoglycemic stimulation of the vagal center and this action is abolished by complete vagotomy.

METHOD

The basic method which we have employed was first described in man by Simici in 1927 who reported the effect of 15 units of insulin intravenously on both the motility and secretion of the stomach in 20 normal subjects (57).

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STUDIES ON VAGOTOMY IN THE TREATMENT OF PEPTIC ULCER

I The Use of Insulin in Testing for Completeness of Vagotomy

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THE relationship of the vagus nerves to normal and pathologic gastric physiology has been studied for many years. The cephalic phase of gastric secretion mediated entirely by the vagi was first demonstrated by Pavlov in 1890 (1, 2) and later confirmed by Ivy (3) and Farrell (4). The copious work in this field has been summarized by review articles (5, 14).

In 1912 vagotomy was first advocated in man as treatment for gastric crises in tabes by Exner and Schwarzmunn (15). In 1915 Exner and Schwarzmunn reviewed the literature and presented 14 cases of subdiaphragmatic vagotomy (16). In 9 patients a simultaneous gastroenterostomy was performed for pylorospasm, decreased gastric peristalsis and atonia. The variability of the anatomy of the vagus nerves was discussed.

Vagotomy as a treatment for peptic ulcer was advocated by Stierlin (17) in 1920. Later, Jet (18), Brucher (19) and Schiassi (20) in 1925, and has since been investigated in both experimental animals and man by many others (8, 10, 11, 14, 21, 34). It has often been demonstrated experimentally that incomplete vagus section produces no significant change in gastric activity (8, 12, 29, 36). Weinstein's 2 attempts at complete vagotomy reported in 1944 (37) were unsuccessful and led him to conclude that complete vagotomy in man is difficult to achieve. Prior to 1943 there are no reports of patients having definite complete vagotomy. Dragstedt's first report of total vagotomy in 1943 (38) and other papers which followed (39-53, 102) have caused renewed interest in the problem. It is

clear from both the long clinical experience with partial vagotomy and the experimental evidence that incomplete vagotomy is of little if any value in the treatment of peptic ulcer. It is therefore of great importance in the evaluation of vagotomy to have a method for testing vagus function following attempted complete vagus section. Two such methods are available: sham feeding (36, 41) and the use of insulin. This paper is concerned primarily with the insulin test of vagus action on the stomach.

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METHOD

The basic method which we have employed was first described in man by Simici in 1927 who reported the effect of 15 units of insulin intravenously on both the motility and secretion of the stomach in 20 normal subjects (57).

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76) Jemerin (36) Dragstedt (41) Thornton (44) and Hollander (89) have used the acid response to insulin hypoglycemia as test for completeness of vagotomy

Our procedure was as follows. The subject was given a standard soft diet at 4:30 p.m. and nothing by mouth thereafter. A Levine tube was passed through the nose into the stomach at 7:30 p.m. and the stomach emptied. Continuous intragastric suction was maintained from 8 p.m. until 8 a.m. for a determination of the night secretion. The determination of night secretion is not an integral part of the insulin test but preceded the test in the majority of our cases. At 8 a.m. a second tube with a rubber balloon attached was passed into the stomach. The balloon capacity was about 200 cubic centimeters but in order to avoid mechanical stimulation only 10 to 50 cubic centimeters of air were used in the balloon during the test. The balloon was placed in the cardia of the stomach and its position confirmed by inflation and gentle withdrawal of the attached tube until there was a slight tug as the balloon reached the cardiac sphincter of the stomach. By this means it was assured that the balloon was not in the pylorus where it might cause mechanical stimulation. The balloon was then only partially inflated and connected to a water manometer. Continuous recordings were made on a slowly moving kymograph.

A control period of basal secretion and motility was then observed for at least 1 hour. The stomach was aspirated continuously and a specimen collected at 15 minute intervals for acid determination. If the acidity of the stomach showed marked spontaneous decrease or increase the basal period was extended until a fairly constant level was reached. Then 14 to 16 units of regular insulin were injected intravenously and the effect on motility and acidity was noted for $1\frac{1}{2}$ to 2 hours. Blood sugar determinations were not made during the preoperative tests but in each instance a determination was made at the height of the hypoglycemia during the postoperative tests as a control. If moderate hypoglycemic symptoms did not occur the injection of 15 units of regular insulin intravenously was repeated at the end of $1\frac{1}{2}$ hours.

If the blood sugar did not fall to or below 55 milligrams per cent during the postoperative test the test was repeated.

RESULTS

Twenty-seven patients with peptic ulcer have been tested before and after vagotomy by the method described. An average of 10 hours of motility tracings was made on each patient. An additional 3 patients had only acid determinations as described making a total of 30 patients.

Acid response. An average preoperative curve of 22 comparable patients with duodenal ulcer is shown in Figure 1. (The acid response in patients having had previous gastric resection was inconstant and is not included in the composite curve.) There was usually an early decrease in the free acid level following the insulin injection. This fact is obscured in the composite curve (Fig. 1) for although the majority had maximal decrease at 30 minutes following insulin 3 patients had a marked increase in free acid at 30 minutes with maximum depression at 15 minutes. The increase in free acid was usually noted between 45 minutes and 1 hour starting at the height of the hypoglycemic reaction. In 3 instances there was no hypoglycemic reaction nor acid response. The test was repeated after $1\frac{1}{4}$ hours with the usual reaction. One patient had a severe insulin reaction requiring intravenous glucose and in this instance only the inhibitory phase was noted. The test was repeated the following day with the usual reaction. Thus it was possible to elicit a definite positive response in all cases preoperatively although in some instances the test had to be repeated before a positive response occurred.

Ten days to 2 weeks after operation 18 of the 22 patients showed no acid response to insulin hypoglycemia. These are considered to have had complete vagotomy. In 12 the free acid was zero during both the basal period and following insulin hypoglycemia. In 3 cases there was a higher basal level than in the above group and following hypoglycemia a marked acid response was observed. These are considered to be cases of incomplete vagotomy. On 3 occasions 1 of the 22 pa-

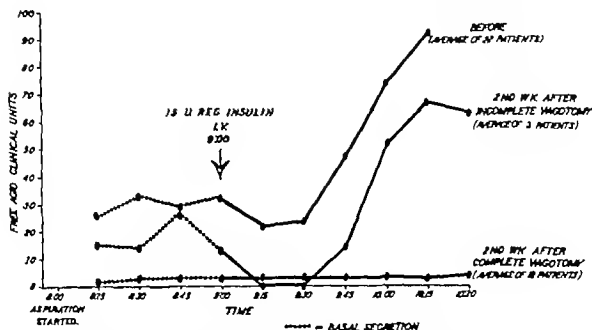


Fig. 2 The effect of insulin on gastric acidity before and after vagotomy

tients whose postoperative curve is not shown on Figure 1 showed a doubtful reaction being midway between the group listed as complete and incomplete.

For analysis of results the response to insulin hypoglycemia may be considered the maximum response to insulin in a 15 minute period minus the maximum secretion in a 15 minute period of basal secretion.

The preoperative response to insulin in 22 patients averaged 53 clinical units of free acidity with a range of 17 to 95 clinical units (The average was 3.7 milliequivalents of hydrochloric acid per 15 minutes with a range of 8 to 6.9 milliequivalents).

The postoperative response to insulin in the 18 patients considered to have complete vagus section was zero.

The postoperative response to insulin in the 3 patients considered to have incomplete vagus section averaged 40 clinical units of free acidity with a range of 34 to 47 clinical units. (The average was 5.1 milliequivalents per 15 minutes with a range of 4.6 to 5.5 milliequivalents.)

The patient in whom completeness of the vagotomy was considered doubtful had a high basal secretion level. The response which followed insulin hypoglycemia was equal to but did not exceed the control basal level.

Motor response. All 27 patients before surgery showed spontaneous type I and occasionally type II or III hunger contractions (Fig. 2). If the insulin was given during a period of gastric activity there was an immediate suppression of hunger contractions. This lasted from $\frac{1}{2}$ to $1\frac{1}{2}$ hours and was followed by a period of hypermotility in the majority of cases. In a few instances the motility pattern following insulin was similar to the control period and did not show hypermotility. There was no constant correlation between the onset of hypoglycemia and that of the hypermotility nor was the onset of the secretory response correlated in any constant manner with the motor response. After surgery 24 of 27 patients tested showed no hunger contractions during either the control period or following insulin hypoglycemia (Fig. 3). The motility tracings showed tonus rhythm but no type I, II, or III hunger contractions. An increase of the fasting period to 22 hours before the insulin test in 7 cases had no effect on the motility. These patients all had a negative acid response following hypoglycemia.

Two of the 3 patients classed above as having had incomplete vagotomy on the basis of the acid response showed spontaneous type I or II hunger contractions postoperatively during the basal control period after 16 hours.

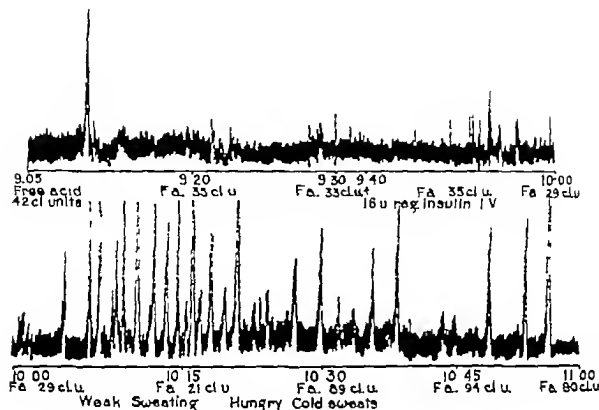


Fig 2. Preoperative insulin test—motility tracing showing spontaneous and insulin induced hunger contractions.

of fasting. The third patient had type I hunger contractions following insulin hypoglycemia.

The patient in whom completeness of the vagotomy was classified as doubtful did not demonstrate definite hunger contractions after operation.

Eight patients who were considered to have complete vagus section were tested 3 to 9 months following vagotomy. The results were similar to the early postoperative tests with 1 exception. This patient had had a transabdominal vagotomy and posterior gastroenterostomy 9 months previously for duodenal ulcer with negative response to the insulin test 11 days postoperatively. Mild ulcer symptoms had returned 3 weeks before testing. Insulin test showed a positive acid response and both spontaneous and insulin induced type I and II hunger contractions.

In summary of the 30 patients tested in 5 vagus section was incomplete in 2 completeness

was doubtful and in 1 vagal function had recurred after a period of 9 months i.e. in 8 patients vagotomy was incomplete or completeness was doubtful. Four of these 8 patients have had recurrence of ulcer symptoms.

DISCUSSION

For many years the action of insulin on acidity and motility of the stomach was controversial. This controversy is explained by the biphasic action of insulin on the stomach (57, 62, 65, 66, 68, 69, 76, 82, 87).

This action has been noted in the preoperative studies, i.e. an initial decrease in acidity and motility is followed by marked increase in the acid and usually motility.

It has been frequently demonstrated that following complete vagotomy in experimental animals hunger contractions are present although they may be diminished (90-97).

Decreased gastric motility with normal or decreased hunger contractions have been

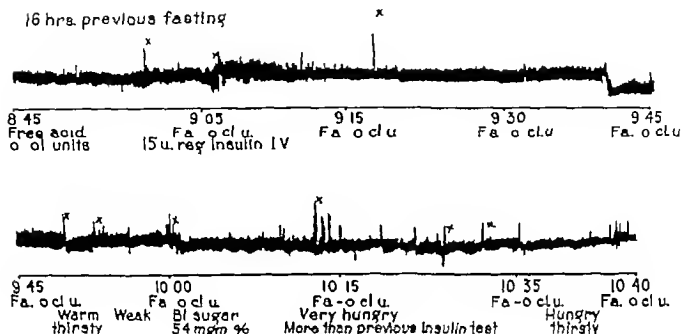


Fig. 3. Postoperative insulin test—motility tracing showing no spontaneous or insulin induced hunger contractions following complete vagotomy

noted in man after vagotomy (43 44 49 52). Our findings indicate that after complete vagotomy there is an absence of hunger contractions in the fundus of the stomach. This difference in findings may be due either to the location of the balloon in the stomach or to mechanical stimulation of motility by distention of the balloon. In order to avoid mechanical stimulation in our tests the balloon was only partially filled using 10 to 50 cubic centimeters of air. The absence of spontaneous or insulin induced hunger contractions in the fundus of the stomach in man following complete vagotomy as compared to experimental animals may be explained on the basis of a difference in vagal function in the two species. It is possible that this may also be related to the fact that man is subject to peptic ulceration a condition rarely seen spontaneously in experimental animals.

Gastric motility and acidity are subject to marked spontaneous variations. It is there-

fore essential to know the status of the gastric activity before a test of gastric function is started. The period of at least 1 hour before insulin is given serves as a control and is designated basal secretion (98-101) and motility. After vagotomy a small amount of spontaneous acid secretion during the basal period will tend to nullify the significance of a similar amount following insulin hypoglycemia.

INTERPRETATION OF POSTOPERATIVE RESULTS

The presence of acid response to insulin hypoglycemia and of spontaneous or insulin induced hunger contractions in the fundus of the stomach is positive evidence of incomplete vagotomy. The acid response to insulin hypoglycemia in cases of marginal ulcer following gastric resection may be unreliable due to the previous removal of acid producing mucosa. Motility studies in these cases before and after vagotomy in which both spontaneous fasting motility and that induced by in-

ulin hypoglycemia are observed are particularly useful as an indication of complete or incomplete vagus section. Such studies have been made in 5 patients, 1 of whom showed spontaneous type I II and III hunger contractions following vagotomy indicating in complete vagus section. In this case the hunger contractions were abolished by a second vagotomy to indicate complete vagus section.

The absence of acid response to insulin hypoglycemia and of spontaneous or insulin induced hunger contractions may be indicative of complete vagotomy. However the following factors must be considered. There must be a sufficient degree of hypoglycemia to produce central stimulation of the vagus. The hypoglycemia must not be too profound or there may be no vagal stimulation.

We have no positive evidence that a physiologically complete vagotomy as shown by a negative insulin test corresponds exactly to a complete anatomical vagotomy. The patient who tested complete after vagotomy and incomplete 9 months later may have had regeneration of the nerves. However a very small percentage of fibers may have remained which did not show function when first tested but which have assumed the functional innervation of the entire stomach.

Anatomical studies have been made in 2 cases. One patient died on the 8th postoperative day of cardiac failure uremia and lower nephron nephrosis following a blood transfusion reaction. Careful dissection of the vagi showed grossly an approximate 99 per cent vagotomy. There were 2 nerve fibrils which branched from the left vagus into the esophagus. It could not be ascertained with certainty if these small nerves reached the stomach. No insulin test was done on this patient.

A second patient died of bronchopneumonia (unassociated with the vagotomy) 3 months after surgery. The postoperative insulin test was negative. Grossly there appeared to be nerve fibers connecting the cut ends of the main nerve trunks (identified by silver clips placed at surgery).

SUMMARY

Incomplete vagus section has little effect on gastric physiology and is of no permanent

value in the treatment of peptic ulcer. In order to evaluate vagotomy it is essential to determine whether complete vagus section has been accomplished. Insulin provokes increased gastric motility and acidity by hypoglycemic stimulation of the vagal center. This action is abolished by complete vagotomy. The literature has been reviewed and a method for testing vagal continuity described. Criteria for the interpretation of the insulin test are discussed.

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THE RÔLE OF TRANSVAGINAL ROENTGENTHERAPY IN THE TREATMENT OF CARCINOMA OF THE CERVIX

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TRANSVAGINAL roentgentherapy has acquired a definite position in the treatment of carcinoma of the cervix judiciously employed. It is a valuable adjunct of the external pelvic irradiation and is capable of replacing with certain advantages the classic methods of intracavitary curietherapy.

Transvaginal irradiation with roentgen rays was tried by many of the pioneers of radiotherapy before radium became widely available. Caldwell and Pennington designed special tubes for the purposes of this and other transvaginal irradiations. Allen pointed at the usefulness of this approach but recognized the necessity of adjunctive external irradiation in most cases of carcinoma of the cervix. Pusey, Duncan, and others observed and reported favorable results. Stuver described vividly the elaborate procedures of one of these early trials. Tousey recommended the usefulness of the Ferguson speculum.

The inadequacy of equipment and dosimetry as well as a lack of understanding of radiophysiology of tumors often led these early attempts to failure and disillusionment and publications on the subject ceased almost abruptly. With a few exceptions (Dachtler) continued trials of transvaginal irradiation of carcinoma of the cervix passed unpublished (Chance treated successfully several patients one of which is reported living 40 years after treatment). With the development of techniques of curietherapy and progressive improvement of results transvaginal roentgentherapy was almost entirely forgotten.

In 1921 Merritt made an attempt to revive this form of treatment but rapidly abandoned it because of the hazards associated with high tension leads and unprotected tubes. With the advent of shockproof equipment Merritt from 1937 on became the forceful advocate of trans-

vaginal roentgentherapy. Abroad, Martius seems to have been the only persistent supporter of this form of adjunctive treatment.

THE PURPOSE

In the majority of cases of carcinoma of the cervix a thorough external irradiation is the most important single factor leading to permanent control. But the external irradiation is seldom sufficient to the task of sterilizing the tumor. The diminution of secondary infection and inflammation and the diminished dimensions of the tumor area, resulting from the external pelvic irradiation make it possible for the internal phase of the treatment to achieve the destruction of the remnant of the tumor. The internal treatment compensates for the insufficient total dose and rather weak daily dose received by the remaining carcinomatous cells. A skillful application of radium, in the uterus and in the vagina, succeeds in controlling the residual tumor in an appreciable number of cases. We have no quarrel with this classic form of treatment that could yet yield better results. The question before us is whether transvaginal roentgentherapy can achieve the same purposes with less disadvantages and whether or not it can improve upon the results of curietherapy of carcinoma of the cervix.

Transvaginal roentgentherapy has been used to substitute the vaginal application of radium only while retaining the intrauterine application (Martius Taylor). This procedure has unquestionable merits since it is the vaginal application of radium that is most often inadequate for several reasons. We have preferred to substitute entirely the vaginal and uterine radium applications in order better to evaluate the merits of transvaginal roentgentherapy.

Transvaginal roentgentherapy may result in a relatively more homogeneous distribution of radiations throughout the cervix and adjacent

structure than is obtained with the use of radium. Consequently the sterilization of carcinoma that is limited to this area can be accomplished with a lesser volume of dose. This fact results in a widening of the margin of safety between the necessary destruction of the tumor and the untoward injury to normal structure. In the treatment of carcinoma arising on a cervical stump the impossibility of introduction of an intracervical radium applicator hampers the choice of a successful radiotherapy transvaginal roentgentherapy is the treatment of choice in this case.

Following external irradiation the irradiation of a single well circumscribed field to the cervix and uterus, and permitting the irradiation of adjacent portions of the parametria is most satisfactory. In contrast, the method permits the daily external irradiation of the potentially malignant area. It is true that with the use of a single field it is possible that could be expected to be effective external rays partially into the parametria but when transvaginal roentgentherapy has been considered external irradiation with attractive and costless tubes may extend to a large pelvic wall.

Wasson and Felson have a very satisfactory technique of transvaginal roentgentherapy in carcinoma in the irradiation of the cervix through four adjacent circular fields in a central overlapping fashion. This seems not to allow irradiation field junctions in an attempt to irradiate more intensively the parametrial region, but it may be observed that it is based upon an experimental study of the physical distribution of radiation. Felson (1947) advocates the use of four adjacent rectangular (2.4 by 3.0 cm.) for the irradiation of the cervix and uterus.

Nolan and Stanbro have made a very commendable physical study of the distribution of radiation throughout the pelvic transvaginal roentgentherapy but this study did not take into account the combined effectiveness of the external and internal irradiation. Although they do not draw this conclusion, Nolan and Stanbro's work may suggest to others that the use of multiple small circular fields is preferable since it may extend further out the theoretically effective dose. This apparent advantage loses its weight when one considers

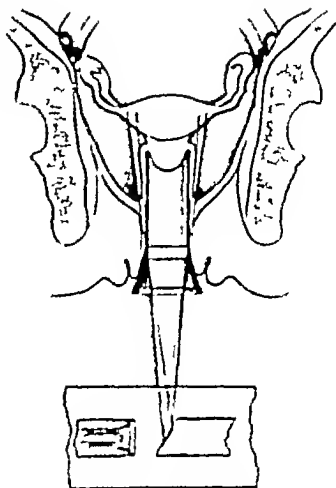


Fig. 1. Diagram illustrating the technique of transvaginal roentgentherapy in carcinoma of the cervix.

that the plane of lateral extension of a tumor cannot be estimated with any degree of acceptable precision. Since human anatomy and tumor spread are variable. The treatment of a wide neoplastic zone by means of blindly directed narrow beams of radiation can seldom be expected to achieve the all inclusive irradiation that is required for the sterilization of the tumor. A revision of this opinion will be justified however if the results obtained by Wasson and Felson prove the superiority of their mature judgment and method.

THE APPARATUS

Schaefer and Witte designed a roentgen ray tube that can be introduced into the vagina to accomplish an intensive irradiation of the cervix. An improved version reported by Martin and Witte deserves further trial. These tubes however generate a beam of low qual-

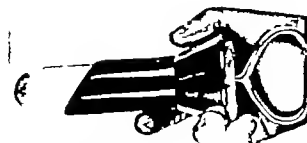


Fig. 2. Vaginal speculum with metal head, plastic shaft, transparent (radiations) and plunger (facilitates introduction).

ity resulting in poor distribution of radiations throughout the tumor. The same is true of the better known contact therapy units.

Transvaginal roentgentherapy can be carried out satisfactorily with standard roentgen ray unit. In the past units of 200 kilovolts have been preferably used for this purpose (Merritt, Wasson) since they offer the unquestionable advantage of a beam of better quality and a greater homogeneity of distribution of radiations in the potentially diseased area than is obtained with lower voltages. Yet the work with 200 kilovolt units imposes a long target-cervix distance and results in greater penetration than is desirable with consequent over irradiation of the bowel. It is for these reasons that we decided to experiment with lower voltages which permit a shorter distance and a greater dispersion of the beam of rays.

We hold the opinion that the internal treatment in carcinoma of the cervix is nothing but a complement of the external irradiation in the majority of cases consequently we feel that transvaginal roentgentherapy should attempt only to counteract the deficiencies of the external irradiation (in total and daily dose) in the center of the tumor area. This step can be accomplished with moderately penetrating radiations. All patients reported in this paper were treated with a 110 kilovolt unit at 25 centimeter target-cervix distance at present we are treating our patients with a 140 kilovolt unit and with 0.5 millimeter copper filtration.

THE SPECULA

As a means of facilitating the passage of radiations through the vagina Merritt recom-

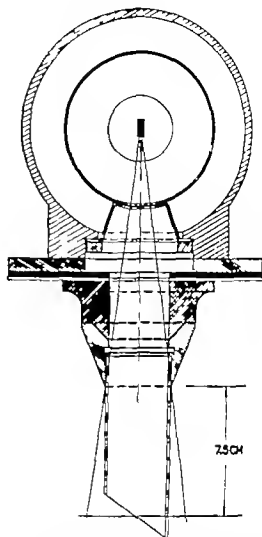


Fig. 3. Cross section of the head and speculum illustrating the widening of the field toward the distal end of the speculum.

mended the introduction of a rubber balloon that when inflated kept the vaginal walls from collapsing. He also utilized glass tubes (made out of urine specimen bottles) but finally adopted the more convenient Ferguson hard rubber or bakelite specula.

Erskine made an ingenious contribution with the introduction of a metal speculum with expanding blades. This speculum is useful in the treatment of early lesions but it falls in its purpose if applied in the treatment of advanced ones for it may provoke bleeding and pain. When transvaginal roentgentherapy has been preceded by external irradiation the



Fig. 4

Fig. 4. A specially fitting metal apron protects the rectum from overirradiation a similar one can be introduced for protection of the bladder

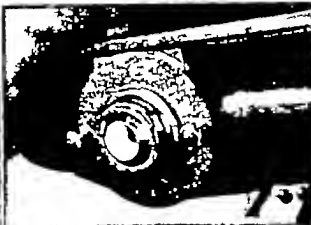


Fig. 5

Fig. 5. Tube-head piece fitting tightly with the speculum



Fig. 6

Fig. 6. Patient in lithotomy position for transvaginal irradiation. Inclination of the table allows the intestines to fall out of the pelvis.



Fig. 7

Fig. 7. Speculum in place



Fig. 8.

Fig. 8. The speculum is kept in place during irradiation by specially fitting tube head piece

cicatricial shrinkage and the mucosal tenderness forbid any attempt of expansion of the vaginal walls.

Wasson has preferred the use of an all metal tube permitting the irradiation of a small circular area. His vaginal tube is very similar to a rectoscope and allows for the insufflation of the vagina for better visualization and aiming of the beam.

During my association with Merritt for the purposes of this study I designed a speculum that avoids the irradiation of the introitus while permitting the expansion of the beam of rays through a shaft transparent to radiations (Figs. 2 and 3). In its present form the use of this speculum results in the irradiation of a circular field that opens to 6 centimeters in diameter at the level of the cervix the pro-

tection of the rectum or bladder is facilitated by removable metal aprons placed within the shaft of the speculum (Fig. 4). The specula are shaped to fit tightly in a special tube head piece that keeps the speculum in place during the irradiation (Figs. 5, 6, 7 and 8). For the requirements of our work we use a set of three specula with different diameters (3.6, 3.8 and 4 cm.) and removable shafts of three different lengths for each of these specula.

THE TECHNIQUE

Following a course of external pelvic roentgenotherapy lasting approximately 6 weeks our patients receive their course of transvaginal irradiations without interval of rest. During this period the moist radioepidermitis of the skin which has resulted from the external

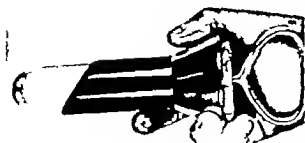


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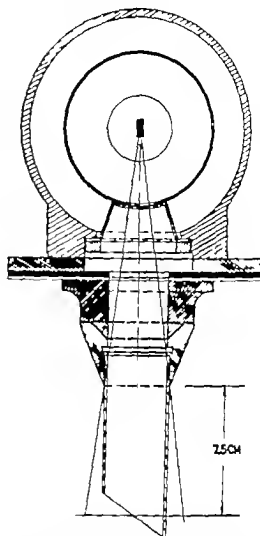


Fig. 3. Cross section of tube-head and speculum illustrating the widening of the field toward the distal end of the speculum.

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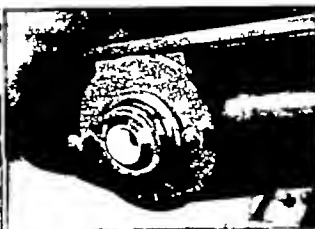


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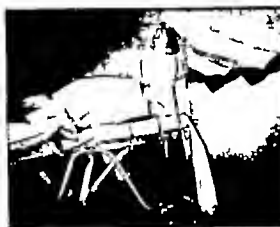


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Bowel complications following radiotherapy of carcinoma of the cervix are neither constant nor fatal, provided that adequate medical or surgical attention is given in time. While an attempt should be made to avoid excessive irradiation through adequate evaluation of doses administered the adoption of a technique of treatment that will with certainty avoid these intestinal complications will result in too marked a reduction of the proportion of cases that are controlled.

Two patients developed an episode of hematuria and pollakiuria approximately 18 months following treatments. In both instances the symptoms subsided without complication. No other urinary complications have been noted after treatment.

Although 12 of the treated patients presented invasion of the bladder or rectum, only in 1 case did a rectovaginal fistula develop during the course of external irradiation. There have been no other fistulas. Three patients who presented evidence of bladder invasion as demonstrated by cystoscopy (and in 1 case by biopsy) are at present free of disease and without development of vesicovaginal fistula. The more homogenous distribution of radiations that results from transvaginal roentgentherapy and the slow and uniform atresia of the upper vagina that invariably follows are probably responsible for the low incidence of fistulas—another desirable feature of transvaginal roentgentherapy.

THE RESULTS

The only available statistic of 5 year results after transvaginal irradiation is the recently reported one by Merritt and Caulk who obtained 95 survivals (32 per cent) in a series of 294 patients in all stages that were treated in this series; however included numerous instances of association with radium therapy. Of 23 cases of carcinoma of the cervix stage II that were treated with external irradiation intracavitary curietherapy plus transvaginal roentgentherapy 12 patients (52 per cent) survived 5 years.

From February 1943 to June 1944 76 patients with carcinoma of the cervix, not pre-

TABLE I—ANALYSIS OF 3 YEAR RESULTS OF EXTERNAL PELVIC ROENTGENTHERAPY FOLLOWED BY TRANSVAGINAL ROENTGENTHERAPY, IN 76 CONSECUTIVE CASES OF CARCINOMA OF THE CERVIX

Stage	Number of patients	Dead of intercurrent diseases	Living with cancer	Dead with cancer*	Average survival in months	Well without symptoms 3 years or more	Per cent
I				4		6	
II	30	3			7	4	
III					6	1	
IV	14			0	5	3	
Total	76	4	1	11		34	44

*For the circumstances not permitting an assurance to the contrary.

viously treated, applied for admission to The Ellis Fischel State Cancer Hospital, no patient was rejected and all but 2 with advanced disease received a complete external irradiation followed by transvaginal roentgentherapy. Radium was not used in any case.

Four of these patients died of intercurrent disease and without signs of recurrence before 3 years had lapsed following treatment. Three other patients are at present living with apparent recurrences or metastases. Thirty-five patients have died of cancer or in circumstances that do not permit the assurance that cancer was not the cause of death. A report of the absolute number of local recurrences is not possible since the majority of these patients were not seen by us in the terminal stages, but the majority of them died without vaginal ulceration, bleeding or discharge. Twelve of these patients presented evidence of distant metastases. It is our clinical impression that most of them succumbed to the development of parametrial or extrapelvic recurrences or metastases without local recurrence. The average survival of these 35 patients was 14 months, but the survival was longer the earlier the stage of the disease (Table I). The length of survival of these patients and the elimination of infected bleeding ulcerations justifies the undertaking of treatment of all patients that apply.

In 2 patients treated for a stage III carcinoma of the cervix a postmortem examination revealed no evidence of carcinoma in the pelvis in spite of a very zealous search (several

CONTRIBUTIONS OF ANIMAL EXPERIMENTATION TO THE TREATMENT OF SURGICAL SHOCK

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NEXT to anesthesia and antiseptics perhaps no other single factor has contributed more to the advancement of modern surgical therapy than the introduction of efficient methods of prevention and treatment of shock. In this development the contributions of animal experimentation have been of very great importance.

When it became possible with anesthesia and antiseptics to operate painlessly and obtain wound healing with a low incidence of infection all fields of the body were gradually invaded by the surgeons and operations of greater magnitude were introduced. This increased the frequency and amount of blood loss and correspondingly the frequency and severity of circulatory disturbance accompanying operations. Also as surgery was extended to structures within or bordering on the abdominal cavity increased difficulty was encountered postoperatively in the administration of water and food by mouth and there was greater loss of fluid from vomiting than before. Both accidental surgical and war wounds posed similar problems of loss of blood and body fluid and of inadequate fluid intake.

During the first decade of the antiseptic era and in most quarters for many years there after the causation of surgical shock was inadequately appreciated. This was because the medical profession was so deeply imbued with the age old idea that shock was a state of marked depression brought on principally by lowering of the blood pressure through either psychic or afferent nervous reflex action. Also treatment, aside from hemostasis was then directed mainly toward overcoming the nervous depression by rest, wrapping in blankets the giving of stimulants and hot drinks and the application of heat externally.

The administration of fluids for the purpose of increasing the circulating blood volume and the body fluids of the tissues at that time

received remarkably scanty consideration in terms of future developments. In 1831 Thomas Latta established the feasibility of administering fluids parenterally. He treated cholera patients in a state of collapse and dehydration by the intravenous injection of large amounts of salt solution with striking temporary improvement and an occasional recovery. However there was little attempt to extend the field of usefulness of this procedure for nearly 50 years during which time there was no report of the use of saline infusion in the treatment of a failing circulation from hemorrhage.

In 1879 Kronecker and Saunderson (23) published a report entitled *Observation of the Life Saving Transfusions of Dogs with an Inorganic Salt Solution* which was so brief and convincing and had such far reaching beneficial results that it is entitled to rank as a classic in support of animal experimentation. A translation from *Die Berliner klinische Wochenschrift* of 1879 vol 16 p 767 follows:

During some transfusion experiments which were undertaken for special physiological purposes we made the noteworthy perhaps practically useful observation that a solution of 6 gm of NaCl and 0.05 gm NaOH in 1 L of water such as Gaulle used for anastomosis of frogs hearts rendered powerless by pure salt solution (Kronecker) is capable of sustaining the life of a dog threatened by great blood loss.

Two experiments were carried out in the following manner: A carotid artery was severed and as much blood allowed to escape as would flow out. The first dog weighing about 13 kgm lost 600 gm of blood or about 60% of the total blood volume. The second dog weighing about 7 kgm lost 275 gms of blood or 50% of the total blood volume. Since the cardiac action was then very weak in both animals they were given as much alkaline salt solution as they had lost of blood. Both dogs recovered completely and rapidly and several days after the operation all traces of effect of the hemorrhage had disappeared. Cats appear not to tolerate transfusions of this solution.

Two dogs bled out from a divided carotid artery and then transfused with an amount of salt solution equal to the blood loss recovered

From an analysis of his experiments, Crile was of the opinion that the most important cause of shock was paralysis or exhaustion of the vasomotor center as a result of nerve impulses set up in the injured field. He was unable to produce fall in blood pressure by direct injury to nerves and more frequently produced increase in pressure. In none of the experiments could it be said that a response to nerve stimulation was the sole cause of the fall in blood pressure. Hemorrhage was regarded as of great importance in the causation of shock in major operations and injuries. Deep anesthesia was also found to increase the amount of circulatory embarrassment or failure. When local anesthesia was used he thought that impulses harmful through their effects on the vasomotor centers were blocked and that the circulation was less embarrassed than when general anesthesia was used. Damage of tissues from anemia was regarded as of great importance and the central nervous system was the structure that suffered most.

In the treatment of experimental shock Crile found that intravenous administration of salt solution was beneficial but that in severe injuries and operations it was ineffectual. He thought that prevention of shock was the goal to be aimed at and stressed the necessity for careful hemostasis and handling of tissues and wherever possible the use of local instead of general anesthesia.

Crile later developed a plan of treatment for the elimination of shock based on the theory of anoci association. By the blockage of nerve impulses with local anesthesia elimination of psychic influences by suggestion performance of the operation presumably unbeknown to the patient and support of the circulation by fluid administration a shockless operation was attempted.

Many of his theories were highly speculative and have not stood the test of time but his recognition of the importance of hemorrhage and his introduction of a successful technique for blood transfusion were a great stimulus for future work which has helped to place the treatment of shock on an enormously improved basis.

Blood transfusion was obviously the logical treatment for shock in which there was great

loss of blood however despite success in dogs the high incidence of transfusion reactions in man made it a dangerous procedure that in the past had been rarely attempted. It was only after the discovery of isoagglutinins by Landsteiner in 1900 and the subsequent establishment of the four blood groups by Jansky and Moss that blood transfusion became a relatively safe procedure. In 1907 Crile performed blood transfusions on the dog by direct cannula anastomosis of artery with vein, and later used this method successfully in man by anastomosis of the radial artery of the donor to a forearm vein of the recipient. Freund, Bordet and Gengou observed in animal experiments that the coagulation of blood collected in a paraffin or vaseline coated vessel was markedly delayed. Curtis and David worked out a successful technique for transfusion on dogs using a paraffin coated glass flask with two cannulas at the lower end for connection with donor and recipient. The blood was drawn into the flask and then forced into the recipient by pressure from a syringe attached to the other end. It was subsequently used with success in human transfusions. Kimpton and Brown modified the apparatus by leaving off one cannula. After drawing blood from the donor, the cannula was withdrawn and quickly inserted into the recipient without the occurrence of clotting. After successful tests on the dog this technique was applied to man and remained in extensive use for many years.

The syringe-valve methods of transfusion were similarly worked out on dogs and after their safety had been established they were used on man.

The introduction of sodium citrate for the prevention of coagulation was the last great step in the establishment of safety and practicability of blood transfusion. It had long been used in a 1 per cent solution as an anti-coagulant for blood drawn from experimental animals. Agote in 1915 and independently Lewisohn in 1915 perfected the technique determined the toxicity and standardized the dosage in citrate transfusion performed first experimentally on dogs and then on man. Since then the citrate method has come to be almost universally adopted for the performance of blood transfusion.

During the period of World War I there was still a great deal of confusion as to the causes of surgical shock which helped to retard the employment of efficient methods of treatment. For this reason there was not full utilization of blood transfusion which had just then become available for the treatment of shock. Animal experimentation carried out after World War I and during World War II was of great importance in more accurately establishing the causes of shock and improving methods of treatment.

The three factors that were considered of greatest importance in the production of shock were local loss of fluid from the circulation, nerve impulses, and toxins formed in the damaged tissues. Experiments 3 4 5 27 28 29 37 38 carried out under anesthesia principally on dogs and to a lesser extent on cats and other animals have since established the fact that by far the most important cause of shock is extensive local loss of blood, plasma or both from the circulation. Local fluid loss causing shock was accomplished by bleeding limb trauma, prolonged constriction of a limb in testicular constriction or manipulation and burning. Calculation of the amount of fluid lost has shown that in animals healthy at the start of the experiment it is sufficient to be either the principal or the sole cause of shock.

Animal experimentation has served to detract from rather than to augment, the nervous theory of shock. Traumatic and electrical stimulation (16 30) of somatic nerves, as the sciatic, of anesthetized normal animals may be carried on for prolonged periods without causing a fall in blood pressure or shock. Wang (36) reported that sciatic nerve stimulation in a dog suffering from bleeding will lower blood pressure and produce shock but not so in an unbled animal. If in a dog experiment (31) the common iliac artery is ligated and the limb pressure lowered thereby to 50 to 70 millimeters of mercury the limb may be hampered as much as 25 per cent more than is necessary to produce marked swelling and shock in controls without the initiation of shock. There is, however, marked injury to nerves and the flow of impulses should be equal to or greater than that from the hampered limb without arterial ligation conse-

quently the reason there is no shock is that there is not enough hemorrhage into the limb to produce it and not because of lack of nerve impulses from the traumatized field. Spinal anesthesia in dogs, while lowering the blood pressure to an average of 75 millimeters of mercury protects from limb trauma shock (15 31) but the protection is not from blocking a flow of nociceptive stimuli from the traumatized region, but from lowering the blood pressure which reduces by about 50 per cent the amount of blood lost when the limb is traumatized. The only purely neurogenic experimental method of producing shock is to stimulate the cardioaortic or carotid sinus depressor nerves (32 33) but in order to result in shock the blood pressure must be kept there by at low level for hours, a condition that never happens from operation or injury in man.

As a result of recent animal experimentation, the tissue toxin theory has fared as badly as the nervous theory. The shock of the crush syndrome appears to be due not to toxins but principally to loss of plasma into the limb after release of the compression as shown by the dog experiments of Duncan and Blalock. Roome and Wilson found that if the tissue juice expressed from the traumatized limb of one dog was circulated in a heparinized dog no significant fall of blood pressure or shock followed as might be expected were it to contain toxins.

The effect of animal experimentation showing that blood and plasma loss is the outstanding cause of shock and that nerve impulses are of minor importance has been to increase enormously the use of blood and plasma in the prevention and treatment of shock in man. The results have been little short of revolutionary as may be seen by reference to their use in both civilian and military practice. By their preoperative employment, patients who were either greatly debilitated from disease or in acute circulatory failure from loss of circulating fluid have been resuscitated and put into condition to tolerate operation when it was necessary. During operation careful track is kept of the amount of blood lost and in all major procedures it has become routine to transfuse blood simultaneously in amounts equal to the blood loss. Because of this pro-

cedure it has become possible to perform successfully operations that are two or three times as extensive as those that could be done before. This has resulted in great expansion of the field of operative surgery and great improvement in surgical results. Patients have been saved from extensive injuries and burns which were almost invariably fatal before the inauguration of extensive blood and plasma transfusions.

Animal experimentation has been of importance in the development of blood substitutes which may be of great assistance in emergencies where blood is not available. Ivy and co-workers carried out studies in which dogs were bled out from the carotid and the volume of blood lost was replaced by various blood substitutes except in a control series where the mortality from the hemorrhage amounted to 84 per cent. The mortality was reduced by the replacement with different blood substitutes to the following levels: saline to 58 per cent, pooled serum to 26 per cent, heparinized plasma to 6 per cent, and gelatin causing the least pseudo agglutination in vitro to 40 per cent. Citrated plasma and citrated whole blood and gum acacia and pectin solutions when given volume for volume were toxic and caused death in a high percentage of cases. Adams and co-workers have pointed out that citrated blood and plasma are rarely given for the treatment of hemorrhage in man at a rate greater than a liter per hour and in this dosage the citrated blood is not toxic. Gelatin solutions for the treatment of shock were introduced by Hogan in 1915 on the basis of experimental studies on rabbits. Levinson and co-workers have recently reviewed the literature and reported on the use of gelatin in the treatment of shock in dogs produced by graded hemorrhage. It worked so well that they did not hesitate to recommend its use in man.

Gum acacia was first used for blood replacement in experimental animals by Czerny in 1894. This caused Hurwitz to use it in a 6 per cent solution for the treatment of shock in man. Acacia solutions were extensively employed for years and many good results obtained but the relatively great incidence of toxic reactions has caused them to be abandoned for blood and plasma.

There have been numerous and conflicting recent reports on the use of saline for the treatment of hemorrhage wound trauma and burns. Animal experimentation has shown that the use of heat may be detrimental in the treatment of shock. Blalock and Mason (6) found that cooling the traumatized limb of dogs reduced the incidence of shock. Cleghorn found that when the environmental temperature varied between 72 and 95 degrees the severity of the shock from hemorrhage or trauma in dogs varied directly with the temperature.

Studies on animals have been made of the effects of various drugs that have proved to be successful stimulants in the treatment of shock, as epinephrine, ephedrine and caffeine citrate and their doses standardized. Oxygen consumption was shown to be decreased in shocked animals by Aub. This established the basis for oxygen therapy which has proved so beneficial that it has become a routine in the treatment of shock.

Various general anesthetic agents have been administered to animals in shock produced by hemorrhage, trauma, and bowel strangulation and comparison made of the way in which they are tolerated. Evans and Beecher (13) reviewed the literature and reported experiments which showed that in dogs in shock from bowel strangulation and plasma loss into the abdomen, the anesthetics employed ranked as follows in order of preference: ethylene cyclopropane, nitrous oxide gas and ether. On the strength of the experiment, Beecher recommended that either cyclopropane or ethylene should be the anesthetic of choice for operation on a patient in shock or approaching shock. Evans (13, 14) subsequently studied the influence of intravenous sodium pentothal and of chloroform on dogs in shock from muscle trauma or intestinal strangulation. They were both inferior to ethylene and cyclopropane when used during resection of the strangulated loop of bowel but intravenous sodium pentothal was no more toxic when administered even for 3 or 4 hours to the shocked dog that was not subjected to an operative procedure.

The blood bank which has played such an important rôle in the treatment of shock had

its beginning in Russia in 1928 with the studies of Shanov on the use of preserved blood of dogs. Skundina and Barenbaum demonstrated in experiments on dogs that the blood in the vessels of cadavers kept at zero temperature for 6 to 7 hours preserved its vital properties and that when transfused it participated in gaseous exchange in a normal manner. This demonstration led to the collection of citrated human blood for subsequent transfusion purposes. The result was a rapid evolution of the blood and plasma bank which has spread throughout the world and become an essential unit in every hospital for the proper control of shock.

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A COMBINED PERINEAL AND ABDOMINAL OPERATION FOR THE REPAIR OF RECTAL PROLAPSE

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THE term rectal prolapse is commonly used in reference to three distinct conditions (1) simple prolapse of the rectal mucosa (2) intussusception of the sigmoid colon into the rectum and (3) true prolapse or procidentia of the rectum a condition invariably associated with a herniation of the pouch of Douglas. It is only with the last named entity that this paper is concerned.

True rectal prolapse or procidentia develops as a herniation of the pelvic peritoneum. It is associated with a defect in the transversalis fascia and a weakening and elongation of the suspensory ligaments of the rectum (6, 8). As the peritoneal pouch descends it carries with it the anterior rectal wall as in any sliding hernia. Gradually by constant pressure the secondary support of the rectum provided by the levator ani is thinned out, the anal sphincter relaxes, and the mass protrudes through the anal canal. For a while by contraction of the levators the mass may be reducible but in time these muscles become so weakened that manual reduction is necessary. In neglected cases the mass protrudes on the slightest exertion and the sphincter muscles become so atrophic as to appear to be paralyzed.

In the surgical treatment of this condition two principal approaches have been used—the perineal and the abdominal. The basic difficulty with the perineal approach is that it attacks the defect at the wrong end. Even the more extensive operations do not completely eradicate the hernial pouch or close the defect in the transversalis fascia. Of the various abdominal operations the Moschcowitz procedure as originally described is well conceived (6). It attempts to obliterate the hernial sac and to suture the defect in the endopelvic fascia, a point emphasized by Moschcowitz but frequently neglected today. But there are

two reasons why the Moschcowitz operation has not been uniformly successful. The first of these is the inherent difficulty in reaching the defect in the fascia from above without actually mobilizing the rectum. Certain modifications of the Moschcowitz operation (4, 5) attempt to overcome this objection but even when the rectum is mobilized the transversalis fascia and suspensory ligaments in some subjects are deep in the pelvis and hard to suture. The second difficulty with the abdominal approach is that the frayed out levator cannot be sutured and a long redundant rectal loop still tends to prolapse. In such cases some type of perineal repair is necessary also. It is an interesting fact that in half of Moschcowitz's original cases some type of perineal operation was combined with the closure of the pouch of Douglas.

No originality is claimed for the operation which is described in this paper. It is a more radical procedure than has hitherto been thought justifiable and one which prior to the days of chemotherapy might well have carried a prohibitive mortality. It consists of the following steps, each of which has been advocated by others: (1) by the perineal approach—(a) circular amputation of the prolapsed segment of rectum (3), (b) excision of the redundant hernial sac, (c) suture of the levators anterior to the rectum (1, 2). (2) by the abdominal route—(a) mobilization of the rectum and suture of the transversalis fascia (4, 5), (b) obliteration of the hernial sac and closure of the pouch of Douglas by circular suture (6), (c) fixation of the pelvic colon to the lateral wall of the pelvis (7).

TECHNIQUE OF OPERATION

As soon as the diagnosis is made, the patient is advised to keep the mass reduced as much as possible and to strengthen the anal sphincter and levator ani by frequent regular voluntary contractions. He is told literally to con-

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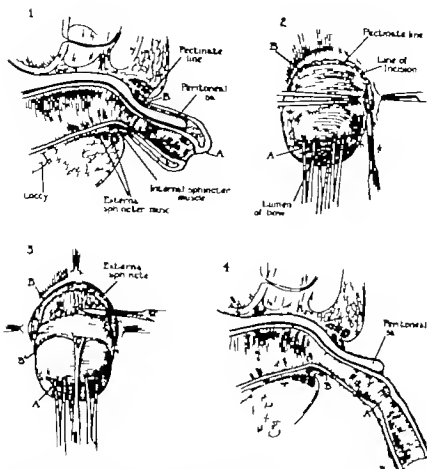


Fig. 1. Diagrammatic representation of the anatomy at the beginning of the operation.

Fig. 2. A circular incision is made through the outer loop of bowel 3 centimeter above the pectinate line, on the rectal side of the pectinate line in order to leave an adequate cuff for the anastomotic anastomosis.

Fig. 3. By sharp dissection the outer loop is unfolded thus exposing the peritoneal pouch.

Fig. 4. The relationship after the outer loop has been freed.

tract his sphincter one thousand times a day. The importance of this maneuver can not be overemphasized. Tone can be restored to the anal sphincter by voluntary contraction as in any skeletal muscle which has become atrophic from disease. The patient is hospitalized for approximately 1 week prior to operation during which time these measures are continued and the bowel is prepared by the administration of sulfasuxidine or sulfaphthaldine in appropriate doses.

The perineal operation is performed first. Spinal or general anesthesia may be used. With the patient in the lithotomy position the prolapse is drawn down and a circular incision

is made in the rectal mucosa about 0.3 centimeter above the pectinate line (Fig. 2). As this incision is deepened, the outer loop of bowel may be peeled off the inner loop thus exposing the hernial sac (Fig. 3). The relationships are shown diagrammatically in Figure 4. The size of this pouch of peritoneum varies but in all of our cases it has been large enough to be dissected off the bowel as a distinct sac (Figs. 5 and 6). The sac is then opened and the neck is closed by circular sutures as high as these can be conveniently placed (Fig. 7). The redundant sac is then excised (Fig. 8).

The sac is then pushed upward and as the anterior rectal wall is depressed with the

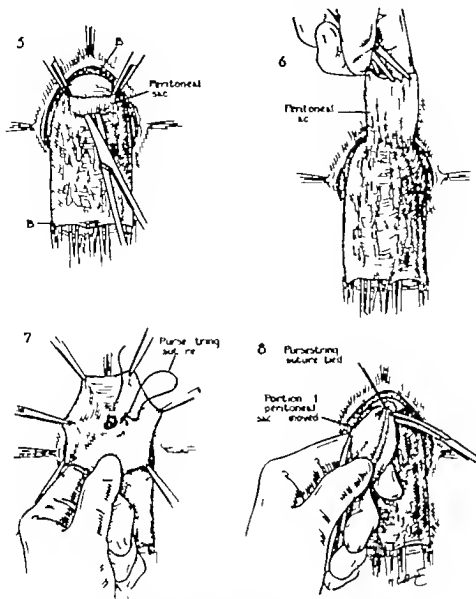


Fig. 5 The peritoneal sac is identified.

Fig. 6 The peritoneal sac is separated from the rectum.

Fig. 7 Circular suture at apex of the peritoneal sac.

Fig. 8 Excision of the excess peritoneum.

finger sutures are placed in the levator muscles lateral and anterior to the rectum (Figs 9 and 10) Good firm muscle can be secured in these sutures. Two or three No. 1 chromic catgut sutures are used to bring a firm barrier across the perineum below the amputated hernial sac and anterior to the rectum (Fig. 11).

The tube of rectum is then split anteriorly and posteriorly (Fig. 12) and traction sutures of fine silk are placed through the entire wall of the bowel uniting it to the distal 0.3 centimeter cuff of rectal mucosa which was left above the pectinate line (Fig. 13) The two halves of the bowel are then excised and two

lateral traction sutures are placed (Figs 14 and 15) These sutures are tied and the remainder of the anastomosis is completed by a continuous lock stitch of fine catgut which is interrupted and tied as it reaches the mattress sutures (Fig. 16) It is important not to complete the anastomosis with a continuous circular suture because the cinching effect of this suture tends to narrow the canal.

The abdominal operation is done as a separate procedure some days later. The abdomen is opened through a midline suprapubic incision. After the pelvic peritoneum is incised on either side of the colon the bowel is mobil

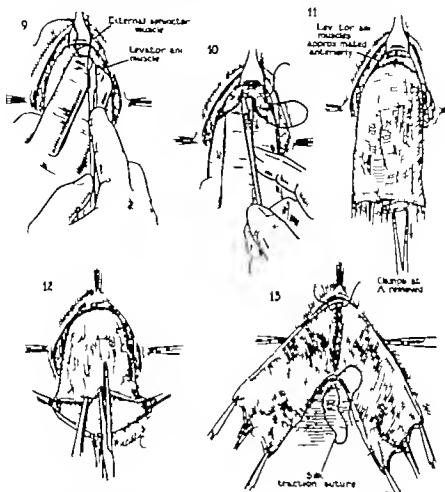


Fig. 9. A catgut suture is placed in the left levator ani anterior to the rectum.

Fig. 10. The same suture in the right side.

Fig. 11. Approximation of the levators anterior to the rectum and below the peritoneal pouch.

Fig. 12. The tube of rectum is split anteriorly and posteriorly.

Fig. 13. Traction sutures of silk are placed at the site of the anastomosis.

ized exactly as in an abdominoperineal resection. It is comparatively easy to do this without injury to the blood supply. After mobilization of the bowel deep sutures are placed including the pelvic peritoneum and the fascial and ligamentous tissue lateral to the rectum. The remainder of the pouch of Douglas is then closed by circular sutures as in the original Moschcowitz operation. Finally the pelvic colon is anchored to the left lateral wall of the pelvis by several interrupted sutures of fine silk. The condition before and after the combined operation is shown diagrammatically in Figures 1 to 17.

RESULTS OF OPERATION

The operation as described, has been performed in 4 patients. The periods of observation since operation have been 1 year and 8 months, 1 year 8 months, and 4 months, respectively. There have been no recurrences. One patient developed an abscess anterior to the rectum and slight retraction of the rectal mucosa at the site of the anastomosis. Moderate stenosis of the anastomosis was controlled by daily digital dilatation. At present, this patient is getting on well without further dilatation. All the patients are continent. Two patients have returned to active life after hav-

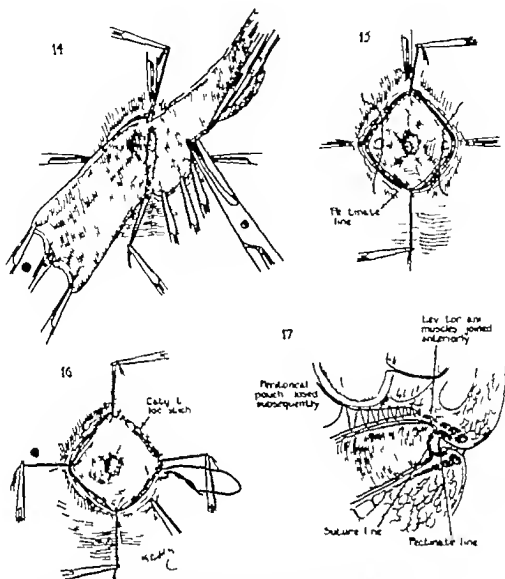


Fig. 14. Excision of the redundant loop of rectum and sigmoid.

Fig. 15. Traction sutures of silk are placed laterally and tied.

Fig. 16. The anastomosis is completed by a lock stitch of fine catgut interrupted at each traction suture in order to avoid the cinching effect of a circular suture.

Fig. 17. The relationship at the completion of the operation, showing the remainder of the sac to be obliterated by the abdominal operation.

ing been incapacitated by complete rectal procidentia for periods of 11 years and 2 years respectively.

The perineal part of the operation alone was performed in a fifth case. Because of the advanced age of the patient, 72 years the abdominal operation has been postponed in definitely. It is now 8 months since operation and no tendency to recurrence has appeared.

In a sixth case a combined abdominal and perineal operation was performed but the abdominal operation was done first and the perineal procedure consisted of posterior fixation of the rectum to the sacral fascia. This

patient has remained well for over 7 years since operation.

DISCUSSION

The great variety of operative procedures still recommended for the treatment of rectal procidentia indicates considerable dissatisfaction with the end results. A study of 12 cases in which patients were operated on in the Peter Bent Brigham Hospital between 1914 and 1938 confirms this impression. In 5 the Moschcowitz procedure alone was employed. There were 3 recurrences. In 3 some type of perineal repair was employed with 1 recurrence, 1 cure and 1 fairly satisfactory result.

In 3 cases both the Moschcowitz operation and some type of perineal repair was performed but the second stage was not carried out until a sizable recurrence had followed the first operation. One of these patients died following the second operation. In the 2 others the end result was fair in 1 and a complete failure in the other.

It would be premature to suggest that a combined perineal and abdominal repair is the final answer to the problem of rectal prolapse. To date the results in our cases have been very gratifying and the procedure despite its magnitude seems worthy of further trial. In early cases before the levator muscles and anal sphincter have been frayed out by constant pressure a repair from above which tightens the suspensory ligaments, closes the defect in the transversalis fascia and obliterates the pouch of Douglas would seem to be sufficient. However in advanced cases some type of perineal repair with suture of the weakened levators should be combined with the abdominal approach.

It has not been established that the perineal repair should be done first. Equally satisfactory results might be obtained by first per-

forming the Moschcowitz operation and then repairing the levators from below without amputating the rectum. This would have the advantage of being a cleaner operation and would eliminate the anastomosis at the anorectal line.

Although the results to date have been excellent this paper should be regarded as a preliminary report. The best solution to this distressing problem still must come from further observation and study.

SUMMARY

The technique of a radical operation combining features of both abdominal and perineal repairs for rectal prolapse is described. The complications and results of this operation are presented.

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OBSTETRICS IN THE SMALL GENERAL HOSPITAL

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THE literature contains many reports of obstetrical analyses. Nearly all of these come from large clinics and hospitals, the great majority from the eastern United States. A personal interest in statistical comparisons was the stimulus for this paper the purpose of which is to present the findings in the obstetrical services of two small general hospitals in the Pacific North west. For many reasons statistical comparisons proved to be nearly impossible. But it is the author's opinion that the results from this community are of interest *per se*.

The analysis is based on the hospital records of 2 500 consecutive mothers delivered in the two general hospitals in Wenatchee Washington during the years 1944 1945 and 1946. The city has a population of about 13 000 and serves medically a population of approximately 50 000 almost all of whom are white. Both hospitals are church directed one Catholic, the other Protestant. One has a rated capacity of 55 beds, with 20 bassinets the other 75 beds and 20 bassinets. Due to the war and to population increases in the area, both institutions ran at 90 to 120 per cent of rated capacity during the 3 years, with a resultant strain on the medical and nursing personnel and space to care for obstetrical patients was a constant problem. Both hospitals are approved by the American College of Surgeons.

They were staffed during these years by 30 physicians 24 of whom practiced obstetrics. There were 2 obstetrical specialists in the group the majority of the deliveries being done by general practitioners. There are no interns or residents in the hospitals.

Statistics regarding ectopic gestation and abortion in patients who were cared for in the hospitals are not included in this paper. It may be assumed that an average amount of prenatal care was given the patients for in general the class of people is high and the value of prenatal care is not underestimated by the physicians of this community. The incompleteness of some of the hospital rec-

ords due to war time pressure however made the preparation of this paper more difficult. It is comforting to find the more recent records much more complete.

In this series, there were 16 pairs of twins delivered an incidence of 1 in 156 deliveries. In this group there were 5 maternal deaths a mortality of 0.20 per cent. This figure may be compared with the maternal mortality for the United States for the year 1940 as prepared by the U.S. Department of Labor (4) of 0.376 per cent. In the same report the State of Washington has a rate of 0.306 per cent 18th in the United States. Newberger, analyzing obstetrical statistics in the State of Illinois during 1943 found a maternal mortality rate of 0.27 per cent in hospitals which had a comparable number of deliveries.

Of the 5 deaths here reported 1 was due to shock and hemorrhage following vaginal delivery of a placenta previa 1 due to acute yellow atrophy 1 to severe rheumatic endocarditis 1 to diabetes mellitus and 1 of a patient in the first stage of labor to ruptured myocardium. Although comparisons may not be made with complete fairness and although this series is admittedly small it is the author's opinion that the mortality rate in the Wenatchee hospitals is very low and speaks well for the care which a general practitioner and a general hospital may give to an obstetrical patient. This is especially true when one considers that there were no deaths nor any serious complications from puerperal sepsis or toxemia. These two complications account for over 60 per cent of the maternal deaths in the United States.

The infant mortality rate here was also comparatively low though less strikingly so. There were 82 infant deaths an overall mortality rate of 3.28 per cent. Of these 28 were stillborn 1.12 per cent of the total babies born. Stillbirth accounted for 34.2 per cent of the total infant deaths. Of the neonatal deaths 24 or 53.7 per cent were due to prematurity (under 30 weeks pregnancy). An analysis of infant deaths appears in Table I.

TABLE I.—INFANT DEATHS

	No.	Wentworth Per cent.	Newberger (Illinois) Per cent.
Total infant deaths	5	3.26	4.26
Stillborns	18		8
Neonatal deaths	24	6	26
Prematurity		33.3*	
Difficult version and extraction	3	3.3*	
Asphyxia	5		
Rh factor	3		
Polyhydramnios			
Epidemic diarrhea	1		
Intracranial hemorrhage			
Abruptio placentae			
Postpartum eclampsia			
Congenital deformity			
Aspiration pneumonia			
Adrenal hemorrhage			
Unexplained	6		

*Per cent of neonatal deaths (in age of the hospital only in which an epidemic of infant diarrhea occurred)

The relatively low maternal and infant mortality figures given invite an analysis of the treatment of the various major complications of pregnancy. The incidence of the major complications in this series appears about average, although it is my opinion that some cases of pre-eclampsia, essential hypertension, and chronic glomerulonephritis were not reported on the hospital charts as such.

PRE ECLAMPSIA

There were 5 cases of pre-eclampsia, 0.20 per cent. In this group 3 cesarean sections were done, with 3 live mothers and infants. In one case of vaginal delivery of a premature infant, death of the infant resulted, in another mother and child both lived. In these cases marked albuminuria and hypertension were present. Attempts at medical control of the symptoms were unsuccessful. That there were other cases of mild pre-eclampsia, unreported on the charts, appears likely.

ECLAMPSIA

Three patients with eclampsia, 0.12 per cent of the total obstetrical cases were delivered 1 by cesarean section in which instance

mother and child survived 2 vaginally (induced labors) in which premature infants died. All 3 of these mothers had antepartum convulsions. None had any noteworthy postpartum complications. The patient delivered by cesarean section had not had antepartum care and was first seen with epigastric pain and muscular twitchings with two convulsive seizures while under anesthesia.

No cases of essential hypertension or chronic nephritis are recorded. There was 1 maternal death, immediately following delivery of a healthy infant, due to acute yellow atrophy of the liver. This mother had had hyperemesis gravidarum during most of her pregnancy and was first seen here when in active labor.

The incidence of cesarean section in toxemia in our group (4 out of 9 cases) is high. It is likely that some or all of these mothers might have survived vaginal delivery (all were primiparas) but the happy ending for mother and child in these deliveries speaks for itself.

PLACENTA PREVIA

Eighteen cases of placenta previa were delivered, an incidence of 0.74 per cent of total deliveries. 6 were complete and 12 partial or marginal. Eight patients were delivered vaginally with 1 maternal death, due to shock and hemorrhage. All the infants lived. Ten patients were delivered by cesarean section all but 1 of whom were in labor and were bleeding. In this group all the mothers and all but 1 of the infants survived. Six of the 10 patients were primiparas. One of the patients, a primipara, who was delivered vaginally died. The maternal and infant mortality rate for placenta previa in this series was 5.5 per cent.

ABRUPTIO PLACENTAE

There were 3 cases of abruptio placentae an incidence of 0.12 per cent, without maternal death. One patient was delivered vaginally 2 by cesarean section. One of the babies delivered by cesarean section lived the other and the one delivered vaginally died.

CESAREAN SECTION

Of the 2500 deliveries, 74 were by cesarean section an incidence of 2.96 per cent. In this

TABLE II.—INCIDENCE MORTALITY AND INDICATIONS FOR CESAREAN SECTION

Incidence	Arnold Per cent	Chicago Lying-In Per cent	Barnes Per cent	Wenatchee Per cent
Maternal mortality	20			
Infant mortality	1.00		0	0.00
Cephalopelvic disproportion	0.8		7	0.00
Previous cesarean	5.3	26	20.8	40.3
Placenta previa	7	7.0	20	3.3
Cervical stenosis	20.6	7.0	0	3.3
Torsion	4.0		4.8	6.7
Malposition of fetus	7	3	7.6	2.3
	8.8	7		3

regard an examination of the literature is most interesting for the reported incidence of abdominal deliveries varies greatly. In general it seems to be much higher in private than in charity institutions. The lowest incidence found in the reports here reviewed was 1.50 per cent reported by Arnold. Others varied up to 16.1 per cent the general average appearing to be between 2.0 and 3.0 per cent. There were no maternal deaths in the Wenatchee series but the number is too small to be of value in comparison with other reports.

The circumstances under which the cesarean sections were carried out are of considerable interest. Table II gives the reasons for the sections compared with indications in other series. The chief discrepancy between the Wenatchee figures and those of others lies in the relatively high incidence of cephalopelvic disproportion as an indication for abdominal delivery. Our figures show 49.3 per cent done for this reason the highest other figure being 36 per cent. This disproportion however is more likely apparent than real. We have no adequately accurate method of relative measurement of the maternal pelvis and fetal head (if there really is one) and the obstetrical judgment as to the lack of progress of labor. In questionable cases this is probably as good a criterion as any. It is the consensus here that, if there is real doubt as to the adequacy of a pelvis it is better to do a section before the mother is exhausted and the fetus is dead. In this small series at least the results seem to justify the means.

In 20 of the 74 cases cesarean section was carried out by an obstetrical specialist. Of these all were laparotomies. The remainder (54) were done either by general surgeons or general practitioners who do obstetrical surgery. All but 1 of these were classical. One was a hysterectomy for fibroids and bicornuate uterus following classical section.

The low maternal and infant mortality rate in the cesarean sections here reported speaks well for the staff. The relatively few low cervical sections done perhaps do not. Only the obstetrical specialists did low cervical sections. There has been a good deal of argument locally about the relative values of the two

types of cesarean section. Most of the surgeons have held that the ease of performance and speed in doing the classical section outweigh the advantages of the low cervical section. One or two of them however are changing their minds since the figures for this report were compiled. Others will likely do so. Of further interest is the fact that there were no cases of peritonitis following cesarean section—this in spite of the fact that several sections were done more than 24 hours after the membranes had ruptured. Penicillin and the sulfonamides are probably responsible for the absence of peritonitis in some of these cases. Whole blood transfusions were used when indicated but not in the majority of cases.

SUMMARY

For comparative purposes the results of 2500 consecutive deliveries by general practitioners and obstetricians in two small general hospitals are presented.

A brief review of comparable statistics from the literature is given.

The relative incidence of low cervical sections to classical cesarean sections done in this community should be increased.

The general practitioner in a small but well managed general hospital can secure excellent results in obstetrics.

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APRIL 1948

PRIMARY CLOSURE OF HARELIP

THE attempted closure of congenital lip clefts dates back to surgical dawn and the *do s* and the *don s* that guide us today had been well established in the first half of the past century but with the distracting introduction of anesthesia and the control of sepsis these gains were mostly lost in the latter half of the same century and largely neglected during the first quarter of the present. It is temptingly easy to freshen and unite the cleft borders, but that it takes skill and real study of each individual case to obtain an acceptable result has been rather commonly overlooked. In this type of surgery the margin between success and failure is narrow pitfalls are numerous, and luck, if any is mostly bad. Further the area is always in evidence and ironically it is the poor results that attract attention while the factor of an excellent outcome must content himself with the silent

flattery of non recognition. We now see children raised in utter ignorance of an early correction.

The primary aim of any operative plan is to retain free breathing and produce a symmetrical lip and nose of natural appearance without too evident suture marks or other scars. Undue transverse shortening, vertical over length, or both asymmetry of the lip or vermillion or failure to correct vestibular distortions are the more common faults of planning or execution that make for the not pleasing result.

With any congenital lip cleft, partial or complete, there is some actual deficiency of lip tissue but most of the spread of a complete cleft is due to tissue displacement. The first operative move to be undertaken only after sufficient study checked by the use of measuring dividers is to ink in the pattern of cuts that will determine the contour of the nascent lip and nose. Previous study will have also estimated the amount of lip, cheek, and nasal mobilization needed to permit soft tissue adjustments without undue tension. In a primary operation this is made available by simple undermining the extent of which is determined by the needs of the individual case.

The infant's condition and related circumstances are apt to dictate the operative *when* the operator's fancy and the extent of involvement will largely determine the *how*. As a general rule the earlier the simpler. Lip closure in the first two days of life makes possible exhibition of an apparently normal infant two weeks later which is a great comfort to a mother who has by then weathered the first shock. Barring this very early closure simpler operations will still suffice any time be-

tween two weeks and two years later as circumstances dictate without resorting to the more extreme measures

In the baby with partial cleft the undermining might be quite limited but for a wide spread opening in one of similar age the complete cheek mobilization might extend the full depth of the maxilla and up to the orbital border on the cleft side somewhat less on the other. Also corresponding liberation of the ala plus undermining between the skin and lower lateral cartilage through a transverse intranasal incision made along the upper edge of the lower cartilage and in addition some slight trimming of the alar border anteriorly might be needed to raise it. All of the above is to insure proper airway and contour

In early childhood the unoperated upon or maladjusted lip can develop a definite droop as well as increased backward displacement of the ala which demands repositioning by completely separating the two halves of the columella, free undermining of the skin over and beyond the upper lateral cartilage with removal also of a triangular piece of skin and cartilage from just above the alar border. It will take all of this and maybe more to raise the slumped ala to its proper position. This new molding is maintained by suturing

In adolescence faulty or non approximation may have caused lateral divergence of the nose from the cleft side which if sufficiently disfiguring may require complete subcutaneous chisel or saw mobilization and mass fixation with trans-tissue wiring of the freed nasal spine to an upper molar tooth. This to be retained for four to six weeks. The above progressive complexities emphasize the advantages of early correction

There are four merging types of classic single harelip, the partial soft tissue cleft the complete soft tissue cleft the complete lip cleft involving also the alveolar process and

the very wide complete cleft of lip and palate. The first of these can be the most refractory because of sparsity of excess vermilion complicated by a small transverse nostril while the wide open cleft is vermilion lined and the ala is stretched. Regarding the alveolar or the complete bony cleft in the vast majority of cases the separated borders will be quickly drawn together with slight overlapping after any sort of lip closure. This narrowing of the bony cleft is helpful to the subsequent palate closure but it leaves an opening in the upper fornix to be closed at the time of the staphyloplasty or later. Very rarely is the bone resistant to the lip pressure. Forceful approximation of the bony cleft borders is a mutilating practice condemned by writers of the early 19th century revived by dentists in the 1840s of the 90s but happily now almost extinct

There are two general plans of closing the lip-nose cleft, each capable of special modification. The earliest is the Husson Rose plan which eliminates the straight or convex cleft borders by angular or curved excisions which when sutured push upward and downward in a straight line. The length of the line will depend upon the depth of the excision but this procedure is apt to give too long a lip. The second plan more difficult but more adaptable is best represented by Mirault's presentation published in 1844. It consists in preserving an angular flap taken from the upper part of one side of the cleft across the defect and uniting it to the denuded opposite border. Regardless of the type of excision for the tissues that are to be sutured to a vertical line the vertical part should be beveled so the tension will be on the deep-holding sutures with no strain on the superficial ones. In that way possibly with the help of a little radium unsightly scars can usually be prevented

The lip closure of complete double cleft of lip and palate is done in two steps. At the

first step closure is accomplished by adjusting the widespread alae and suturing the upper part of the Rose or Mirault sectioned lateral lip fragments to corresponding areas of the denuded prolabium. So far the procedures are similar. Lower down in the Rose type the prolabium is trimmed to a point, but in the Mirault plan it is cut squarely across if the lip flaps are to interdigitate or to a blunt point if the flaps are to be trimmed to abut in the midline. The cheek ala undermining for the above is greater than in the single cleft for there is no appreciable length to the columella and the premaxilla stands well forward of the maxillae. The septum is not to be shortened at this stage. Doing so might risk letting the premaxilla drift back between the maxillae which is ruinous to both incisor occlusion and to facial contour.

Second step. The premaxilla push back done at the hard palate closure will have caused definite nasal snubbing. Correction of this consists in raising a superficial trifoli flap from the lip in conjunction with the separation of the short columella from the septum. A far forward transverse cut across the septum will then permit the nasal tip to be advanced and leave a corresponding triangular defect in the septum. Sutures the lateral leaves of the trifoli into the septal defect on each side and closing the lip defects will restore continuity to the advancement.

The double clefts may be mirror images or either cleft might fall into one of the four types mentioned above.

In the complete double cleft the premaxilla will be found at the tip of the nose. If there is any attachment between the maxilla and premaxilla on either side no matter how slight the central mass will diverge in that direction. A bilateral attachment, no matter how attenuated will restrain the forward movement of the mass.

There are few primary instances of harelip in which an acceptable result cannot be attained in from one to three operative steps. There are still fewer in which the original possibilities can be attained after a bungled start.

VILRAY P. BLAIR

ROBERT R. ROBINSON

CONGENITAL ATRESIA OF INTESTINE AND COLON

ATRESIA of the bowel is a rare congenital deformity which obviously cannot be diagnosed until symptoms of obstruction appear. Vomiting is the first symptom but since some vomiting in the newborn is not abnormal its significance for a time is not appreciated. If the obstruction is high persistent vomiting will begin shortly after birth. If the obstruction is near the ileocecal valve the most common site vomiting may not become alarming until the second or even the third day of life. Most atresias of the bowel are distal to the ampulla of Vater; the vomitus therefore is green. A newborn baby who vomits green material has intestinal obstruction until proved otherwise. It does not have pyloric stenosis because the vomitus of a baby with pyloric stenosis is never green.

Distention of the abdomen likewise varies with the level of obstruction. Gastric peristalsis moving from left to right may be observed in obstructions of the duodenum or the beginning of the jejunum. One should not be led astray by finding a scaphoid abdomen in these patients. Progressive and finally marked distention of the abdomen however typifies atresias of ileum or colon. Intestinal patterning is usually visible.

The difference between a normal meconium stool and that of an infant with intestinal atresia is not great enough to be impressive. The nurse's notes usually show a record of

'meconium stool. Only one who has had rather extensive experience in the care of infants would notice and realize the significance of the fact that a baby who was vomiting green material had a stool which was smaller in amount lighter green in color and was firmer in consistency than the usual normal greasy consistency tarry meconium stool.

The suspected diagnosis of atresia of the intestine or colon is easily confirmed by examination of roentgenograms made of the baby in the upright position. Widely distended loops of bowel showing fluid levels will be seen. The number of distended loops of bowel and their position in the abdomen will indicate the level of obstruction. These babies should not be given barium; its use is unnecessary for diagnosis; it tends to clog the intestine and if aspirated produces tracheobronchitis.

The treatment of congenital atresia of the intestine and colon is surgical. It is trite to state that the earlier in life these obstructions are corrected the better the results will be and yet at the same time it is advised not to rush these infants to surgery until two conditions are met: first dehydrated infants must be restored to near fluid and electrolyte balance by intravenous administration of isotonic solution of saline 10 to 15 cubic centimeters per pound of body weight plus 50 to 75 cubic centimeters of 5 per cent dextrose solution per pound of body weight. This amount of fluid is sufficient for 24 hours. What part of it is given before surgery is a matter of judgment in each case. Second the stomach must be thoroughly emptied before operation. This is usually accomplished by inserting a No. 10 French catheter into the stomach through a nostril and aspirating with a syringe. The catheter is left in place during operation and following surgery is attached to a Wangensteen suction apparatus.

The operation on these infants is best done under open mask ether anesthesia. The abdomen is opened through a right rectus muscle splitting incision. If the distended loops of bowel are allowed to escape spontaneously from the abdomen there will be little trauma and the pathological condition will be found easily and rapidly. From the point of atresia the undeveloped bowel is followed distally to the rectosigmoid in a quick search for other obvious atretic areas. If none is seen a fine needle is inserted into the lumen of the collapsed bowel and salt solution is injected to demonstrate possible points of atresia; no vision will serve to distend the small caliber bowel and to soften any unspissated material. A large needle attached to a 50 cubic centimeter syringe is then inserted into the distended bowel at the site where the anastomosis is to be done. The distended bowel is completely deflated and as much of the meconium as possible is removed.

A side-to-side anastomosis isoperistaltic or antiperistaltic, is made between the distended and undeveloped bowel. The temptation to do just an ileostomy should be curbed because these infants do not survive ileostomies. The anastomosis is done with No. 00000 Deknatel silk on an atraumatic needle for bringing serosa to serosa and such silk or No. 0000 chromic catgut is used suturing mucosa to mucosa. The sewing must be painstaking in careful spacing of stitches and in avoiding large bites of tissue lest the lumen of the bowel be encroached upon. Although the infant may be in poor condition it should not be forgotten to close the opening between the two leaves of mesentery.

Not infrequently these children do badly during surgery. Stopping all anesthesia and giving the baby oxygen only until the peritoneum is to be closed has been a factor. I am

certain. In avoiding operating table casualties in at least two of these patients at the Children's Memorial Hospital (Chicago) A blood transfusion of 50 to 75 cubic centimeters is always given during the operation.

Following surgery the infant is placed in oxygen. Penicillin 10,000 to 20,000 units is given intramuscularly every three hours. Negative suction on the catheter in the stomach is maintained for at least 48 hours. Feedings of a dilute formula are begun cautiously and in small amounts. If vomiting or distention recur gastric suction is resumed. Food, fluid and electrolyte balance are maintained by routine fluids, blood, plasma and amigen.

Surgical mortality of congenital atresia of

the intestine and colon will always be high for the following reasons. The infrequent abnormality is apt to be overlooked until bowel gangrene is imminent. Multiple atresias of the bowel at times make anastomosis futile. Other congenital abnormalities may be present and add to the risk of surgery. However mortality statistics are tremendously better than twenty years ago. Then recovery following surgery was an oddity. Now because of chemotherapy, wiser use of proper suture material and recognition of physiological requirements a baby with single atresia of the bowel but otherwise normal has a fair chance of postoperative recovery.

WILLIS J. PORTS

THE SURGEON'S LIBRARY

REVIEWS OF NEW BOOKS

DR. CRILE was an inveterate recorder of what he did and of the things he saw and heard a confirmed transcriber of his thoughts on the problems he faced with the result that he left a world of material from which Mrs. Crile has woven a story of his life of absorbing interest.¹ Cited with descriptive ability he has left a travelogue of fascinating beauty covering the countries he visited their natives flora and fauna, their mountains valleys, and cities. But most important he has outlined the trails which he followed in research in which field he has contributed so much. Possessed of an inquiring mind he was ever asking the why and how and was never content until the answer to the problem was at hand. Coming from pioneer stock it was befitting that he became one of the pioneers of the medical frontier leaving an indelible imprint upon contemporary medicine surgery and science. Witnessing the death of his friend William Lyndman from shock started a train of inquiring thought which persisted throughout life and resulted in invaluable contributions in the elucidation of shock its prevention and its control. Out of this research came his accepted offerings on hemorrhage and transfusion.

His work in the Medical Corps of the Army during the Spanish American War and World War I is given in sufficient detail to make clear the valuable contributions he made to the Medical Department in both conflicts. The opportunities for mass observation in the latter aided greatly in his scientific research and reveal his ever incisive and inquisitive approach to scientific problems. While always a scientist and a research devotee he was a humanist with his goal the benefit of mankind and the improvement of human welfare.

His query as to what is life? remains unanswered but from a scientific standpoint he has given us much upon which to cogitate. His indomitable energy his forcefulness and his courage are revealed in his manner of overcoming the vicissitudes of fate with which he was beset and furnished an example and an inspiration to all of us who tread the same path even at much lower levels.

His study of the animal power plant undertaken through years of travel to all parts of the world including all animals from mouse to the elephant is the one comprehensive study of its kind and furnishes statistical data of incomparable value.

¹GEORGE CRILE. *AN AUTOBIOGRAPHY*. Edited, 11th ed. by Grace Crile. 2 vols. Philadelphia and New York: J. B. Lippincott Co., 1937.

The autobiography of this pioneer furnishes revelation stimulation and inspiration in disclosing the creative impulse which marked him as a man apart a man who sought an answer to the secrets of nature and who provided many answers. Undaunted he cheerfully accepted the challenge of his time and seized upon the opportunities which it afforded. His remarkable versatility is reflected in the many fields in which he was interested and in which he achieved distinction. His lofty ideals his vision for the shaping of a better surgical world can be perceived in the policies and accomplishments outlined in his life history. His devotion to the improvement of surgery was ever uppermost in his mind and efforts his part in the development of the American College of Surgeons was but an instance of this urge.

In reading this autobiography one gathers an appreciation of his rich personality his accomplishments his leadership his contributions to science, his dual capacity as a great surgeon and an original investigator pre eminent in both scientific research and surgical technique a master surgeon and scientist a benefactor of mankind. The sidelights by Mrs. Crile disclose that which one would expect a devoted husband and father with ever present love solicitude and affectionate consideration for those near and dear to him. In other words, he was a man among men, a surgeon of the world a scientist seeking knowledge.

IRVING ABELL

THE author has revised his older text *Anatomy for Physical Education* and altered the title to *Concise Anatomy*¹ for the purpose of reaching a wider range of students in fields that pertain to medicine, such as physical therapy occupational therapy medical technology nursing dental hygiene and physical education. The general plan of the book is little changed. New material on the histological and developmental aspects of anatomy is inserted and much of the applied anatomy² found in the previous text is now omitted. The illustrations few of which are original have been reduced from 472 mostly colored in the earlier work to 324 nearly all without color in this volume. The omission of color in depicting nerves blood vessels etc. has resulted in considerable loss of clarity in the illustrations.

The text is indeed concise yet the author has included many complex anatomical details in his account often without adequate descriptive background for their proper understanding. As an ex-

¹CONCISE ANATOMY. By Linden L. Edwards, Ph.D. Philadelphia, Toronto: The Blakiston Co., 1937.

ample, chapter 5 "General Neurology" consists of 54 pages devoted to detailed condensation of the developmental anatomy histology and gross anatomy of the nervous system and meninges and to an outline of the nervous pathways in the central, peripheral and autonomic nervous systems. In addition descriptions of the eye, ear and other sense organs are included. (The course and distribution of cranial and spinal nerves are described elsewhere in the book.) Several complex diagrams of nervous pathways (taken from Morris *Human Anatomy*) are inserted in the chapter. It is doubtful that the beginner will find this chapter very useful.

The reviewer is of the opinion that the reading audience envisaged in the preface to the book (and listed above) is in no position by reason of experience to appreciate a condensed treatise on embryology histology neurology and gross anatomy such as has been produced in this text.

D. V. L. B. ETT

THE more conventional plan of many treatises on the subject of general surgery is presented in *Surgery* by Rafael Urzua. It was written for medical students in the advanced grades of the University of Chile, and to them in his preface the author addresses sound advice regarding the high ideals expected of one who aspires to be the perfect surgeon.

The author has divided his material into four parts, the first of which relates to the general principles of surgery preoperative considerations, the value of a surgical team anesthesia an evaluation of the various forms of anesthetics and their modes of administration treatments of wounds burn and shock, vascular disorders, tendons nerves, and orthopedic problems including amputations.

In the second part the surgery of systems is discussed under titles of surgery of the neck, thorax, extremities, and breast, whereas such subjects as the abdominal parietes, hernia, peritoneum, digestive tract, and anorectal diseases are included in the third part.

The fourth part discusses surgery of the liver gall bladder pancreas, spleen, kidney female organs, and urogenital diseases.

The book is purposely without bibliography as the author believes surgery is learned not from books but from observing it, living it and perfected only by intense study. This book is intended to contain only general surgical principles beyond controversy. There is a generous smattering of illustrations, all of the pen and ink type which are not infrequently in distinct and imperfectly reproduced.

As far as the text is concerned the author attains the aim of his presentation as the subject matter is succinctly treated at times a single paragraph disposes an entire subject. This makes the book a teaching treatise and permits amplification of specific topics by drawing on other sources. It has a synoptic character and because of this its scope appears

exhaustive. It should serve as an excellent review for students and practitioners.

STEPHEN A. ZIRKIN

THE sixth edition of *Recent Advances in Endocrinology* comes after an interval of 3 years during the interim no major changes have been made, and save for the addition of a short section dealing with the treatment of hyperthyroidism with thiouracil and its derivatives the present issue consists mainly of an extension of previously written chapters rather than of correction. As its title implies the book is essentially a collation of current knowledge relating to the whole field of endocrinology. Each ductless gland is considered in detail, the symptomatology of its diseased states is lucidly set forth the underlying alterations in biochemistry and morbid physiology are described in detail and treatment is touched upon. The happy result is a well organized and succinct general textbook of the glands of internal secretion which should be of particular value to the student and to the beginner in the subject. The author emphasizes principles rather than details of therapy and avoids any generalizations as to treatment. Hence the worth of the book to the expert or to a practitioner engaged in following an individual case is somewhat limited. The author has succeeded most satisfactorily in epitomizing the entirety of a complex branch of medicine and his exclusion of any therapeutic dicta is therefore no doubt proper. To a minor extent the volume suffers because of its illustrations which are both old and not well reproduced.

The appearance of the present edition coincides with the death of Dr. Cameron after a protracted illness, on September 25. The author had been professor of biochemistry at the University of Manitoba since 1919 and has been recognized as a foremost authority in his field for the past three decades.

WAYNE CAMERON

THE book *The Foot and Ankle* which is now in its third edition was written with the stated purpose of doing for the foot and ankle what Dr. Hanau did for the hand, that is, to tell the general practitioner what to do for the common conditions that occur in and around the foot. The author has accomplished his purpose by creating a most interesting readable, and workable book that should prove of inestimable value not only to the general practitioner but to medical students and younger orthopedic surgeons as well. It is straightforward in style, comprehensive in scope, and contains many illustrations of good quality. The author's device of using heavy black margin blocks to summarize salient points is a great time saver and also adds to its value as a ready textbook. In general this book is organized to cover in logical sequence the embry-

RECENT ADVANCES IN ENDOCRINOLOGY. By A. T. CAMERON, M.D., M.A., D.Sc. (Edin.). F.R.C.S., F.R.S.C. 4th ed. Philadelphia, Toronto, The Blakiston Co., 1937.
(THE FOOT AND ANKLE) THOMAS J. JONES, DORRIS DEWEES, and DONALD MILLER, 3d ed. By Philip Lewis, M.D. F.A.C.S. Philadelphia, Lea and Febiger, 1937.

CHIRUGIA. By Dr. Rafael Urzua. C.C. Santiago, Chile. Editorial Tegayala, 1947.

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THE USE OF THE TERM "WERTHEIM OPERATION"

The Editor: The revived interest in the surgical treatment of cancer of the cervix raises the question of terminology for the procedures employed. The use of the expression "Wertheim operation" is widespread for any procedure that is supposed to be radical for resection of the uterus and its adnexa. The question of this terminology would be of little importance in itself and would hardly justify comment were it not for the fact that it entails certain inaccuracies and confusion in the discussion of results.

In 1900 Wertheim of Vienna reported 24 operations upon carcinoma of the cervix in which some parametria was excised. In some instances the lower segment of a ureter involved by the tumor was also removed and the upper segment implanted into the bladder. Lymph nodes, macroscopically involved, were excised singly or in small groups. A perusal of the report reveals the wide variation in extent of resection among the patients described. In most instances a small cuff of vagina, not far beyond the tumor was resected. In other instances, most of the vagina was removed.

Booney was one of the staunch proponents of the surgical treatment for carcinoma of the cervix during the years when little else but irradiation was generally advocated. He referred to the operation performed by himself as Wertheim's operation and this contributed in no small measure to the establishment of this term at least in the English and American literature. Booney carried out a more radical procedure than originally described by Wertheim and emphasized systematic pelvic lymph node dissection in stages which the latter did not carry out. More recently in Meigs's writings on the sub-

ject, he refers to the radical hysterectomy with pelvic node dissection which he has developed as a Wertheim operation. Here again his procedures are more radical than those carried out by Wertheim and are more systematically extensive than can be witnessed in the Vienna gynecological clinics today and referred to there as Wertheim operations.

Many operators in carrying out some type of radical hysterectomy for cervix cancer likewise designate their procedures as Wertheims. The writer has witnessed operations, and observed the resulting surgical specimens which in fact were supravaginal panhysterectomies without systematic lymph node dissections and with relatively little pericervical tissue removed that were designated as Wertheim operations.

Obviously when the results of the surgical treatment of cervix cancer are discussed on the basis of

significant series of cases there will be a rather wide divergence in what has been achieved by the Wertheim operation. Under this heading will be grouped the stereotyped panhysterectomies that have been designated Wertheims, as well as the more radical procedures with systematic lymph node dissections.

It would appear, therefore, that there will be advantages in the substitution of the term Wertheim operation by more accurately descriptive terminology such as radical panhysterectomy" with or without limited pelvic lymph node dissection or with systematic iliac, hypogastric and obturator node excisions. Another designation might be radical panhysterectomy with *en bloc* pelvic node resection. With more accurate designations the achievements favorable and unfavorable of the operations might be more correctly evaluated.

ALEXANDER BRUNSWICHT.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

THE FORUM OF FUNDAMENTAL PROBLEMS FOR SURGICAL SPECIALISTS

HOWARD C. NAFFZIGER, M.D. F.A.C.S., San Francisco, California

At the annual Clinical Congress of the American College of Surgeons in the past several years, the Forum on Fundamental Surgical Problems has demonstrated its value and wide popularity. It was instituted to provide an opportunity for the young progressive researcher to present his work. Its appeal to such a large proportion of the members has been a source of great satisfaction to the College. Its value to the specialist was not fully appreciated at the beginning, but it is recognized now that a much needed opportunity is offered for specialists in all surgical branches to keep abreast of progress in the fundamentals.

Attendance at the Forum is huge and selection of this part of the program by such large audiences has a special significance. The specialists in fields other than general surgery have their own societies, meetings, and personal contacts often they have little time and little opportunity to learn of progress outside their own particular bailiwick. At such a Forum as this, the principles of management of infection, nutrition, improvements of anesthesia, the use of blood fractions and blood substitutes, and many other matters are presented. These are of immediate concern to each and every practitioner regardless of his specialty.

The Clinical Congress permits the specialist to renew acquaintance with fundamentals and to keep abreast of the broad advances which contribute to the welfare of all patients. The subsidiary trickles, continuously adding to the stream of medical knowledge, are increasing its volume and the speed of its flow, so that if we are not in it but

remain on the bank, we are promptly left behind. The language of the medical sciences must not become a foreign tongue when the days of our medical school teachings are past and the Forum offers an excellent opportunity as a refresher course.

The specialties are becoming more and more independent and autonomous. This is evident in the tendency toward their establishment as separate departments in our medical schools and by the creation of their own boards of certification and their own special societies. This development has its advantages and its drawbacks. It makes for progress in a narrowed field but inevitably tends toward separation from the broad base of Medicine. If this divergence proceeds too far the superstructure of specialism lacks a sound foundation. With this specialism which has reached its height in this country and with no signs of a tendency to abate, who is to contribute to progress in the fundamentals? So far progress has come largely from the preclinical and basic sciences. On the clinical side, the general surgeons are the particular ones who have contributed the most. Should we as specialists look to that particular specialty called General Surgery to carry on investigations and be responsible for the teaching of the basis of all surgery? It would seem that if the specialties and the specialists are to be worthy of their independence, their interest in broad fundamentals must not only be maintained, but they should contribute to knowledge in the fundamentals as well as in their own special precinct. This is the obligation that is assumed along with independence. The Forum, therefore, fills a special need for the specialist and it welcomes his attendance and his contributions.

Professor of Surgery, University of California Medical School
Member of Board of Regents, American College of Surgeons.

April, 1948

SURGERY
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COLLECTIVE REVIEW

ETIOLOGY OF ENDOMETRIOSIS

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WHEN few facts are definitely known concerning the etiology of a condition, and when the interpretation of the known facts is not obvious, attempts are made to explain the observed phenomena by a workable theory. When all phenomena cannot be satisfactorily explained by one theory, the number of hypotheses purporting explanation multiplies, each being incomplete. When disproof of the various theories is even more difficult than their substantiation, these theories tend to creep insidiously into the minds of practical men as established fact—each man accepting most readily that idea which seems best to explain the phenomena he has observed. When theories concerning the etiology of a condition differ markedly and when the incidence of this condition seems to be increasing, much observation, investigation, and dissertation are thereby stimulated. Thus, in the extensive literature concerning the etiology of endometriosis, King (108) says, "one observes writers regarding the suggestion as fact—or at least intermingling observation and suggestion, so that the disentangling of description from hypothesis becomes extremely difficult. This discussion is an attempt to disentangle observation from suggestion and description from hypothesis concerning the cause of endometriosis."

DEFINITIONS

Novak (145) defines endometriosis as the condition in which tissue resembling endometrium more or less perfectly is found aberrantly in vari-

ous locations. Many authors differentiate anatomically between *internal* endometriosis (or adenomyosis) which is found extending diffusely through the myometrium, and *external* endometriosis which is found on or near the peritoneal surface of the uterus, ovaries, pelvis, or elsewhere in the body. When an isolated area of endometrial tissue, surrounded by fibrous or smooth muscle tissue, forms a discrete, individual tumor it is often called an endometrioma, or when located within the myometrium it may be called an adenomyoma.

The terms endosalpingiosis (occasionally found) and endocervicosis (rarely reported) are self-explanatory in the light of the foregoing explanations.

A detailed list of terms from several countries, which have been used to name various manifestations of endometriosis, has been compiled by Hosai (93).

CLASSIFICATION OF THEORIES

A consideration of the etiology of endometriosis must include evaluation of (I) the theories concerning histogenesis, and (II) those concerning possible stimulating influences. The theories concerning histogenesis may be divided into three general groups: (A) those which imply that ectopic endometrial tissue is transported from the uterus to its pathological location; (B) those which imply that ectopic endometrial tissue develops *in situ* from local tissues; and (C) combinations of these two groups. Theories postulating transport from the uterus may be named as follows: (1) the implantation theory, (2) the mechanical transplantation theory, and (3) the metastasis theory. Theories postulating development *in situ*

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may be named as follows: (1) the celomic metaplasia theory, (2) the ovarian metaplasia theory, (3) the dedifferentiation theory, (4) the embryonic cell rest theory, and (5) the direct extension theory. Of the many possible combination theories postulating both development *in situ* and transportation thence to final pathological sites, only one, which for lack of a better name is called the uterine endometriosis theory, will be discussed herein. Malignant changes will be considered briefly. Factors which may possibly stimulate the development of endometriosis will be discussed under three general headings: (A) mechanical, (B) inflammatory, and (C) hormonal.

HISTORY

The first known report concerning endometriosis was written by von Rokitanaky (165) who described an adenomyoma in 1860. Following this only a few scattered reports are available until the 1890's when a number of German and American investigators became interested in the subject. During the first two decades following 1900 studies of the subject were continued by these men—principally Cullen (24, 25, 26, 27) and Meyer (128, 129, 130, 131)—who published careful and extensive reports of their findings. However, Cattell and Swinton (19) were able to find less than twenty reports concerning endometriosis in the world literature prior to 1921.

In 1921 Sampson (174) published the first of his series of reports in which the implantation theory of endometriosis was recorded. These papers awakened wide interest in the subject of endometriosis in this country, and since that time the literature on this subject has expanded even out of proportion to the increasing frequency with which the disease is being observed.

A chronologically arranged history of the literature concerning endometriosis is tabulated in the appendix hereto.

I. THE HISTOGENESIS OF ENDOMETRIOSIS

Theories concerning the origin and method of development of endometriotic tissues will be discussed under this general heading:

A. ECTOPIC ENDOMETRIUM TRANSPORTED FROM THE UTERUS TO THE PATHOLOGICAL SITE

1. *Implantation theory* (following retrograde menstruation through the tubes) Sampson introduced this theory in the early 1920's, basing his ideas upon clinical observations and pathological studies (174). He first described "perforating hemorrhagic cysts of the ovary" and theorized that an abnormal corpus luteum may have de-

veloped due to invasion of endometrial tissue present at the site of rupture, and that "with the advance of the epithelial invasion the luteal membrane retrogresses to the extent that the mature cyst may be reined. (In this connection Kahanpaa reports the presence of endometrial glands and stroma in a *wonag corpora lutea*). Sampson stated, 'Usually there is a vascular stroma not unlike that of the endometrium between the epithelium and the ovarian tissue' and, 'structures like uterine glands may be present in this stroma.' Also in this first paper Sampson reported endometriosis in the cul-de-sac of patients who had only tiny pockets of endometrial-like epithelium in their ovaries, but who had much dense fibrous tissue around the ovaries. From this he concluded: (1) that endometrial cysts of the ovaries were sometimes lesions of relatively short duration, (2) that the characteristic adhesions resulting from their bursting and regression may persist long after the cyst has disappeared, and (3) that the material escaping from them may give rise to adenoma of endometrial type in other tissues. He called the lesions adenoma of endometrial type because: (1) they were histologically similar to endometrium, (2) they manifested activity (periodic hemorrhages) during the patient's menstrual life and (3) in some patients the ectopic endometrial tissue corresponded to the phase in the cycle indicated in the menstrual history."

During the next year Sampson (184) noted that various ovarian and peritoneal lesions of endometriosis seemed to be of the same age and histological structure in some individuals. Therefore he sought a common source for the endometrial tissue of these lesions. Naturally patent tubes were considered as possible avenues through which mullerian tissue might escape into the peritoneal cavity.

In 1922 Sampson (175, 176) presented his theory that bits of uterine and tubal epithelium were extruded from the fallopian tubes by retrograde flow during menstruation, and that they implanted, usually on the ovaries, but occasionally on the peritoneal surface of other pelvic structures, especially in convenient "pockets." This theory was based on several observations, namely: that endometriosis was seldom found in women under the age of 30, that both tubes were patent in 284 of the 293 patients which he studied (184), that endometrial hematomas usually developed on lateral and inferior surfaces of the ovary—the parts most likely to be soiled by material extruding from the tube—and that endometrial hematomas were often bilateral. To this, he

added another hypothesis, specifically that the ovary is an "intermediary host a hotbed or incubator of endometriosis" for the epithelium apparently expelled from the ovarian cysts seemed to him to be more vigorous in new implantation sites than the epithelium which seemed to have come directly from the tube to an extraovarian implantation site (175-176). (However while studying additional material (184) Sampson observed that extensive peritoneal endometriosis can occur without any ovarian involvement, and he finally concluded "Therefore the suggestion that the ovary may impart greater virulence to the Mullerian epithelium growing on it is unwarranted.")

These unusual theories naturally stimulated a great deal of interest and controversy. King (108) studied the same type of ovarian lesions as did Sampson, but derived therefrom a different interpretation which will be discussed later. Ewing and Novak (142) pointed out that endometrial islands are usually found deeper within the tissues than would be expected of surface implantations. Novak also pointed out that typical endometriosis is found in the umbilicus where implantation is improbable. However Campbell dissected the umbilical area of patients who had umbilical endometriosis, and was able to satisfy himself that the long tracts of scar tissue he found were the remains of small hernial canals into which endometrial tissue might have implanted after extrusion from the tubes. On the other hand Enzer observed a dimpling on the peritoneal surface of an umbilical endometrioma removed from an 18 year old girl. The invaginated area was serially sectioned but no evidence of implantation was found. "The lining epithelium resembled by periplastic peritoneal cells. (See celomic metaplasia theory.)"

Hirst reported the case of a 19 year old girl who for 3 years prior to operation, had menstruated into her peritoneal cavity with much associated pain. The operative findings included a rudimentary blind vagina a solid cervix widely patent tubes, normal ovaries containing a fresh corpus luteum but no endometriosis or adhesions.

This patient should have been an ideal subject, for the development of endometriosis according to the retrograde menstruation theory. However Yin reported the case of a 19 year old girl who for 2 years prior to operation had menstruated painfully into her peritoneal cavity. The operative findings included an atresia of the lower vagina, a uterine lumen dilated with tarry blood and endometriosis of the bladder wall intestines, omentum tubes, and right ovary. In these 2

cases similar anomalies interfered with normal vaginal menstrual flow, yet one patient developed endometriosis and the other did not. Apparently some factor other than or in conjunction with retrograde menstruation is necessary for the development of endometriosis. (See mechanical factors.)

The discussion thus far has dealt with large elements of theory laced together by clinical and pathological observations. Let us consider what other facts are available.

Autotransplantation of endometrial tissue into the liver spleen abdominal wall, and/or anterior chamber of the eye has been successfully accomplished in smaller experimental animals, first by Goldzieher in 1874 then by Stilling in 1910 and later by Hesselberg *et al.* Jacobson (98-99) Spirito Allen and Bauer Gleave, Harbitz, Kirchsky and others. Stilling observed that adenomas of various sizes were formed which were lined with ciliated columnar epithelium and which contained fluid under pressure. Cyst walls would regenerate after excision of a portion for microscopic section. Kirchsky noted that the vascular changes of an intraocular endometrial transplant in pregnant rabbits corresponded with the changes within the uterine endometrium. Spirito reported success in transplanting endometrium either to the same animal or to an animal of the same sex and species, but no success has been reported in attempts to transplant endometrium to animals of different species.

Jacobson (100, 101) Fraser and Markee have transplanted healthy nonmenstrual endometrium in monkeys. Jacobson found successful transplants were confined to the uterine serosa and adhesions. However Fraser reported takes in the serosa of the bowel and umbilicus and Markee was very successful with implants into the anterior chamber of the eye. Thus, healthy surgically transplanted nonmenstrual endometrial tissue will usually survive, flourish and respond to those hormones which normally effect intrauterine endometrium.

Heim (80-81) Traut, Caffier Hirsch and Jones, and Katz and Szenes succeeded in culturing endometrium taken from surgically removed uteri which were not in the menstrual stage. Traut found that this healthy endometrium grew best in a culture of corpus luteum hormone, grew fairly well in embryonic extract, but died within 6 days in a culture of ovarian follicular fluid.

However Novak and TeLande (146) stated that menstrual discharge tissue is necrotic, containing chiefly autolyzed constituents with few if any formed elements during the first 2 days of the

menstrual flow and no demonstrable endometrial tissue after the first 2 days. It was considered reasonably doubtful that such sloughed endometrial tissue would retain sufficient viability to implant itself survive, and flourish. Meyer (133) wrote that if the viability of menstrually discharged endometrial particles could be definitely proved, the first question concerning the implantation theory would be answered.

To study the viability of endometrial particles during menstruation, Cron and Gey obtained small bits of tissue from the human uterus on the second day of menstruation with a dull curette and were able to keep the tissues alive for a month in cultures. Some glandular hyperplasia was observed but the explants did not become grossly larger. However by using a curette they may have obtained tissue from the deeper portion of the endometrium which normally would not have sloughed during menstruation, and which may logically be expected to show greater viability than would menstrual particles obtained without instrumentation. Therefore, Geist collected human menstrual blood in a test tube at the cervix. It had been argued that menstrual particles small enough to pass through the interstitial portion of the fallopian tube would be necrotic so Geist aspirated some menstrual blood from the test tube through a capillary pipette which he considered to be approximately one-third the diameter of the average interstitial tubal lumen. He then placed the aspirated material on a slide where he stained it supravitality. He interpreted his findings to mean that endometrial cells are living and remain alive for at least an hour after they escape from the cervix. This, however is not proof that the cells would have sufficient viability to implant and live on ovarian or peritoneal surfaces.

Craig has summarized the observations of various investigators of this subject as follows: "Tissue culture experiments on the viability of endometrium have shown that postmenstrual endometrium grows easily and rapidly. Interval endometrium also is grown without difficulty. Premenstrual endometrium is more difficult, but endometrium obtained during menstruation is scarcely viable and extremely difficult to grow."

The question then arises: Is there a sufficient degree of viability to sustain endometrial particles until implantation can occur? In an attempt to answer this question Heim (82) implanted desquamating menstrual mucosa from either monkeys or human beings into the peritoneal cavities of monkeys. In no instance was he able to find any takes. He was also unable to produce pelvic endometriosis in monkeys by creation of utero-

abdominal fistulas which permitted leakage of menstrual blood into the pelvis. Hartman reported the histories of 2 monkeys. The first, when received from the shippers in the jungle, was found to have a complete, spontaneous or traumatic separation between the cervix and the body of the uterus. The cavity of the uterus contained bits of bone and sludge. The connection between the uterus and cervix of the second animal was surgically severed by TeLinde, and some months later an exploratory laparotomy was performed. Neither animal had any blood or endometriosis in the pelvis or abdomen. Thus, available experimental evidence indicates that menstrually discharged endometrial particles lack sufficient viability to implant and grow in a manner comparable with intermenstrual endometrial particles.

In some of the experiments herein reported the viability of endometrial particles passing out of the cervix was assumed to be the same as the viability of endometrial particles which might pass out of the fimbriated end of the tube. This assumption has never been checked directly; however Sampson (180) compared the microscopic appearance of uterine mucosae (1) obtained at curettage, (2) obtained from vaginal menstrual blood, and (3) obtained from a cast of the tube. He found what he interpreted to be healthy cells and cell groups in all 3 types of specimens. Westons (214) examined blood taken from the cul-de-sac of patients who were operated upon at the time of menstruation. He observed red blood cells, leucocytes, endometrial cells, and clumps of amorphous debris therein. Thus, endometrial type cells which may have traversed the fallopian tube in a retrograde direction have been recognizable microscopically. However it is pertinent to mention that loss of physiological function would precede structural change so that histological structure is not an exact criteria of cellular viability.

In 1925 Rubin (166, 167) and Lee (114, 115) studied the physiology and anatomy of fallopian tubes—Rubin studying human beings and Lee studying dogs, cats, and guinea pigs. Both concluded that uterotubal insufflation is most difficult at the time of menstruation, or its equivalent (from 180 to 200 mm. Hg. pressure being required in human beings). Just after menstruation ceases the pressure necessary for insufflation usually is only about 70 mm. Hg. in human beings, and it remains at this point until about the time of ovulation when it starts to rise again. Lee discovered that the uterotubal junction was guarded in all observed animals by fibromuscular folds—which were grossly viable in the pig. Neither he nor

Rubin could see such a structure in the human uterus, but one of Rubin's uterosalpingograms (167) shows possible evidence of such a "sphincter" between the uterine cornu and the interstitial tube. From his studies, Rubin concluded that spasm of the tube is rare (occurring in 9 of 450 cases) but that in the presence of a foreign body in the tube peristalsis toward the uterus takes place. He also states that reverse peristalsis may occur occasionally (168) and if so this would favor retrograde menstruation.

Finally Markee in elaborate and painstaking experiments, transplanted endometrium under sterile precautions, to the anterior chamber of the eyes in 41 monkeys. Using high magnification he made daily observations of the changes within the endometrial transplants during 432 estrus cycles. Among his observations concerning menstruation he mentions the following:

1. Menstruation is preceded from 2 to 6 days by a decreased blood flow to the mucosa.
2. There is a marked vasoconstriction from 4 to 24 hours before menstruation begins.
3. Shedding of the fragments starts a day after the beginning of menstrual bleeding.
4. Fragments usually disintegrate and disappear within from 30 to 60 minutes after they are shed.

5. In not a single instance during the entire 432 cycles did reimplantation of a shed fragment occur although the original implants of healthy endometrial tissue had established themselves with ease in every instance in which infection did not supervene.

This is the only experiment in which the course of endometrial fragments which were shed during menstruation onto a favorable implantation site has been observed in vivo and reported. The uniform absence of secondary implantation and the rapid disintegration of shed fragments are definite although not incontrovertible, evidence against menstrual regurgitation as the usual etiologic agent in the production of pelvic endometriosis.

2. *Mechanical transplantation theory* Transplantation into laparotomy scar. In 1916 von Franke first suggested that laparotomy scar endometriosis may result from surgical transplantation of endometrial tissue. He reported a case of scar endometriosis following repair of a uterus which ruptured early in pregnancy. Danforth (33) and Heaney in 1925. Nicholson in 1926 and others (5, 54, 75, 78, 94, 182, 185) have reported instances of endometriomas of the laparotomy scar following surgery in the pelvic region. In 1949, Wepi and Kletzhandler reported that during the preceding 16 years they had removed 73

scar endometriomas, 5 following cesarean section and 68 following hysterotomy. They also reported that, since changing their surgical techniques, their incidence of postoperative scar endometriosis following these operations had dropped from 3.4 per cent during the early years of the report to 0.9 per cent during recent years. In his comments on this report Greenhill in 1942 stated that the previous world literature had contained only 390 cases of scar endometriosis, which he classified roughly as follows:

REPORTED POSTOPERATIVE SCAR ENDOMETRIOMAS

Operation	Number
Ventrofixation	113
Cesarean section	41
Hysterotomy	49
Other openings made in uterus	26
Adrenal operations	51
Appendectomy	18
Vulvar vaginal perineal scars	43
All others	49
Total	390

Sampson's studies (181, 182, 185) have made it apparent that, if records were adequate for the purpose, these scar endometriomas should really be separated into two groups: (1) those which developed by direct extension (see direct extension theory) and (2) those which developed following actual transplant of endometrial tissue.

Hosal and Meeker (94) and Pankow mention instances in which scar endometriomas were discovered as long as 26 years after childhood appendectomies. Sampson theorizes that such lesions develop from bits of an endosalpinx transferred from the tube to the wound on gloves or gauze by the exploring surgeon.

There is no doubt that endometrial tissue can be transplanted during surgical procedures either accidentally or intentionally. Hasselberg *et al* successfully transplanted uterine tissue into abdominal muscles and into ear tissue in guinea pigs. Bykow successfully transplanted the entire uterus of immature dogs to the omentum. Both investigators observed little if any tendency toward proliferation of the transplanted myometrium. Bykow stated that only the endometrium exposed by amputation showed a tendency toward active proliferation. In this connection Jacobson (99) made a simple incision in pregnant uterus of rabbits and was later able to demonstrate endometrial cysts in the region of the incision. Harbitz transplanted endometrium into peritoneal and pleural cavities. These transplants became rapidly cystic, acting in that respect similar to other transplanted epithelia.

(skin, mucosa of mouth, ureter [225]) The pleural transplants became rapidly extrapleural, cystic, and then polypoid.

Transplantation into lower genital canal. As previously stated, Greenhill recorded 43 instances from the world literature, in which vaginal, vulval, or perineal scars contained endometriomas. Hosal (93) mentions instances of menstruating fistulous tracts in the vaults of vagina following complete hysterectomies. Lash and Rappaport (113) in 1943 found only 5 cases of primary cervical endometriosis in the literature and added a sixth of theirs. In each of these 6 cases a traumatic lesion of the cervix from abortion, curettage, or childbirth had preceded the onset of symptoms by several years. Thus, there is some evidence that endometriosis of the lower genital tract may result from mechanical transplantation.

Transplantation to pelvic organs following curettage. The evidence for this possibility may be stated as follows:

1. In 1925 Rubin (166) condemned the use of uterine irrigations following curettage because at subsequent laparotomies he had frequently seen the pelvis inundated with fluid which had washed through the tubes.

2. In 1927 Sampson (180) reported that at laparotomy following curettage, he frequently observed blood from the uterus escaping through the tubes into the pelvis.

3. In 1944 Hartman did a series of experimental hysterectomies on monkeys during which he attempted, by excision and vigorous wiping to remove all vestiges of endometrium from the uterus. Not only did the intrauterine endometrium regenerate completely in from 14 to 30 days, but there were numerous takes of spilled endometrial fragments on the external surface of the uterus, some producing "chocolate cysts," and nearly all, when studied, showing cyclic activity parallel to that within the uterus.

4. In 1946 Curtis (31) recorded 2 similar instances which had been brought to his attention. Both patients had laparotomies at which incidentally no endometriosis was noted. Later both were subjected to dilatation and curettage, followed immediately by Rubin tests. Some time after this, both required laparotomies for the treatment of pelvic endometriosis.

5. It should be repeated here that Rubin (168) has occasionally observed what appeared to be reverse tubal peristalsis under the fluoroscope when opaque material was in the genital canal.

Thus, there is no proof but only suggestive evidence that bits of healthy endometrium broken off by a curette may flow or be forced out of the

tube with blood and may implant on the surrounding peritoneal surfaces.

3. *Metastasis theory* Lymphatic metastasis. In 1924, Halban (72) first recorded his belief that the presence of endometrial like tissue found deep beneath apparently normal peritoneum was not explainable upon the basis of any prevailing theories, but was explainable only on the basis of spread through the lymphatics which drain the uterus. A year later Halban (73) reported 5 cases of endometriosis in which he attempted to show that the lesions were distributed along the course of the lymphatics. He also referred to uterine mucosa found in inguinal, sacral, iliac, and parametrial lymph nodes of women by Ries, Wertheim, Meyer, Frankl, and Lahn, and stated that no such tissue had been found in similarly located glands in men.

In 1925 Sampson (177) could not rule out the possibility of lymphatic metastasis in the etiology of inguinal endometriosis. Later while studying endosalpingiosis (182) he injected dyed gelatin under moderate pressure into the uterine lumen before he cut tissue blocks. In one section he demonstrated a gelatin filled, endometrial gland growing within the lumen of a lymph vessel in the tubal wall. This could be interpreted only as evidence that endometrial tissue may travel, at least by extension, through lymph vessels. (It has been suggested that such extension through lymphatics is the usual mode of development of adenomyosis (58). In the rare condition known as stromal endometriosis, extension of endometrial stroma through the lymphatics is usually observed.)

Hansmann and Schenken reported the autopsy findings in 2 young women. One died of a transfusion reaction but had chorioepithelioma. The other died of gunshot wounds, but had ovarian endometriosis. Therefore, the pelvic lymph nodes were sectioned and in both instances glandular cysts lined with ciliated, columnar epithelium and surrounded with endometrial stroma-like tissue were found within the nodes. Russell (169) found multiple small glands lined by columnar epithelium and surrounded by decidual cells in the cortex of an abdominal lymph node of a young woman who died of hemorrhage following rupture of an ectopic pregnancy.

Whether these glandular and stromal findings within lymph nodes are due to metastasis of endometrial cells, or are due to metaplasia of the lymphatic endothelial and stromal cells (83, 180) is not known. Sternberg and Carere-Comes have reported decidual reactions in axillary parotid, and submaxillary lymph nodes. An ectopic decidual reaction does not necessarily indicate that

ectopic endometrium is present. However it does show a predisposition of the local tissue to respond to hormonal stimuli in a manner similar to endometrial stroma by the development of decidual like cells (144).

Thus, the evidence for lymphatic metastasis is incomplete. Further studies of this subject will likely emanate from the autopsy room.

Venous metastasis. As early as 1925 Sampson (177) suggested the possibility that endometrial particles might get into venous sinuses and be carried thence to an abnormal location there to implant and grow. In 1936 Navratil and Kramer (138) reported the removal of a date sized fibrotic mass of endometriosis from the external carpi radialis muscle of the arm of a 25 year old girl who had a previous therapeutic abortion. Three years after excision of the arm lesion she was suffering severe symptoms of dysmenorrhea and menorrhagia and Navratil (137) removed her uterus. The uterus showed generalized adenomyosis.

By 1939 Philipp and Huber (154) reported that there were 3 known instances of endometriosis of an extremity and since then there have been others—the most recent being the report by Schlicke, in 1946 of a nodule removed from the posterior aspect of the thigh of a Filipino nurse. For 3 years prior to the operation this nodule had become larger and more tender just before and during menstruation, and had regressed in size and tenderness during the interval between.

If endometriosis of an extremity is to be considered as evidence for venous metastasis of endometrial particles, one of the following two assumptions must be made (1) either a patent foramen ovale or similar defect existed in the cardiovascular system and shunted blood past the pulmonary vascular system, or (2) an initial endometriosis existed in the lungs and metastasized to the extremity. Neither has been reported. However another histogenetic explanation for the existence of endometriosis of the extremities will be discussed later (see celomic metaplasia theory).

Schwarz reported the case of a woman who had inguinal endometriosis, and who had definite epistaxis with each menstrual period until she was subjected to x ray castration. However after a meticulous study of rhythmic changes in the skin capillaries, Brewer pointed out that menstruation which is evidenced as a local vascular phenomenon is in reality a part of a demonstrable generalized vascular phenomenon present in the entire body. In light of this conclusion the reported epistaxis could be explained more logically as bleeding evoked by these generalized vascular

phenomena, from any one of several common pulmonary lesions rather than from a hypothetical pulmonary endometroma.

Experimental endometriosis of the lungs was produced in rabbits, by Jacobson (102) in 1932 and by Hobbs and Bortnick (88 89) in 1939. Bits of autogenous endometrium were injected into the rabbits ear veins in saline suspension or in autogenous serum suspension. Jacobson found apparently viable, embolic cells in the lung up to 1 week after injection, but no longer. No cells passed through the lungs to other organs. Hobbs and Bortnick gave their rabbits theelin in oil preoperatively to stimulate endometrial growth. They were able to find endometrial implants in the lungs of 8 of 12 rabbits.

Thus, the evidence for venous metastasis is incomplete. It seems likely that if healthy endometrial particles were present in the venous blood from the uterus they would be filtered out and implanted in the lung rather than elsewhere.

B ECTOPIC ENDOMETRIUM DEVELOPED IN SITU FROM LOCAL CELLS

1 *Celomic metaplasia theory* This theory of the origin of endometriosis has evolved gradually as the result of observations, experiments, and writings of many men principally Waldeyer Iwanoff Meyer (131) Novak (143) Heim (83) and Gruenwald (67 68 69 70 71). In its present form simply stated, it is this: the muellerian (paramesonephric) duct is derived from the embryonic celomic epithelium and mesenchyme, and forms most of the female genital tract including the endometrium. Other adult derivatives of these embryonic celomic cells may retain the potentiality of forming tissue which is histologically and functionally indistinguishable from endometrial tissue.

To evaluate the celomic metaplasia theory it is first necessary to consider the most recent fundamental embryological studies which have a bearing thereon. These have been reported by Gruenwald (67 68 69 70, 71).

Early in embryonic development the cells lining the celomic cavity have a characteristic appearance. As Maximow reported, in 1927 the celomic surface of these cells forms a smooth lining for the celomic cavity. However the basal border is irregular. There is no basement membrane. The lining cells send cell processes into the mesenchyme and continually "bud-off" cells into it, thus giving rise to part of the mesenchymal tissue (Fig 1).

Soon, however in the human embryo of 8 mm the celomic lining differentiates into true epitheli-

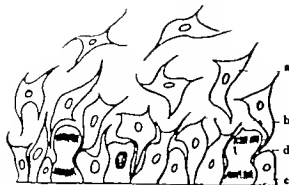


Fig. 1. Lining of celomic cavity—early. Cell surfaces lining the celomic cavity are rather smooth (a), but then opposite surfaces are irregular and there is no basement membrane (b). Lining cells send cell processes (c) into the mesenchyme and continually “bud-off” cells (d) to it, thus contributing to mesenchymal cell content (e). (Adapted from Gruenwald [7].)

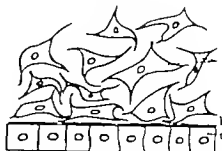


Fig. 2. C-ionic epithelium (8 mm. human embryo). The celomic lining differentiates into true epithelium (a) at basement membrane (b). It no longer contributes cells to the mesenchymal tissue (a). (Adapted from Gruenwald [7].)

um with a basement membrane, and it no longer contributes to the mesenchymal tissue (Fig. 2).

The third phase in the embryonic history of the celomic lining was described by Filatow (45) in 1933. A blastema is formed by the following process:

At specific places the celomic lining epithelium dedifferentiates to its original condition, sending cell processes into the mesenchyme and budding off cells. Such blastema forms the primordium for the gonads and limb buds (Fig. 3). (At the time of formation, portions of some of the blastema are in the embryo's future thoracic region, i.e., the upper end of the gonad and the cephalad limb bud.) The organs thus produced inherit and under normal conditions, repeatedly demonstrate a greater tendency than other bodily tissues toward interchanges between epithelial and mesenchymal structure.

Gruenwald put these facts together and then went on to study the development of muellerian (paramesonephric) ducts (67, 68). He observed, as had his predecessors, that the paramesonephric duct originates by an invagination of celomic epithelium near the cephalad end of the wolffian (mesonephric) duct, and of the gonad, and grows caudally just under the coincidentally developing tubal ridge, which is a thickening of the celomic epithelium. He discovered that the two ducts are at first clearly separated only at the moment of invagination, and that thereafter the paramesonephric duct grows caudally within the basement membrane of the mesonephric duct. He also discovered that epithelium of the paramesonephric duct buds off mesenchymal cells on its dorsal and lateral surfaces, which separate the paramesonephric and mesonephric ducts. Up to

this time, he observed that the ventral surface of the paramesonephric duct usually rests directly on the basement membrane of the thick tubal ridge. However, the tubal ridge epithelium now buds off mesenchymal cells which separate it from the paramesonephric duct. All these mesenchymal derivatives of epithelium rapidly become histologically indistinguishable from the surrounding mesenchyme (Fig. 4).

These facts are beautifully illustrated in high power photomicrographs of specially stained sections of human and chick embryos in Gruenwald's several publications. They may be presented in diagram form (Fig. 5).

The implications with reference to endometriosis are summarized neatly by Gruenwald (69), as follows:

1. The celomic wall, including epithelium and connective tissue, is developmentally related (progenitor) to the muellerian (paramesonephric) ducts, and therefore may be regarded as a possible bearer of the developmental potentialities of endometrium formation.

2. This potentiality may be carried into other organs which develop from blastema derived from the celomic wall, i.e., the gonads, adrenals, and limbs.

3. Nonepithelial tissues of the uterus are particularly closely related to uterine epithelium, since they are formed by that epithelium during embryonic life.

4. Spontaneous endometriosis in all known locations may originate from local tissues.

More specifically, cells which are descendants of the celomic epithelium, and which therefore may retain the potentiality of endometrium formation, are present in large numbers in the upper genital organs and the pelvic peritoneum, but also are present, perhaps to a lesser degree, in the following listed locations in which endometriomas have been occasionally reported:

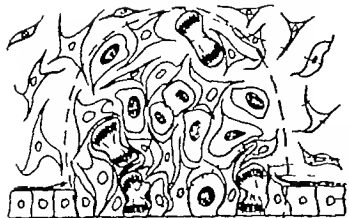


Fig. 3. Blastema formation. The colonic lining epithelium differentiates at specific places, sending cell processes (c) into the mesenchyme and budding off cells (d) to form blastema (a) which are the primordia for gonads, and limb buds. The surrounding epithelium (f) and mesenchyme (b) retain their normal cell structure, separated by a basement membrane (e). (Adapted from Gruenwald [71])

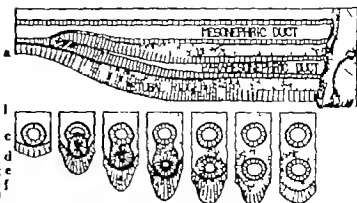


Fig. 4. Development of a paramesonephric duct (diagrammatically represented by a sagittal section above with corresponding cross sections beneath). Since the paramesonephric duct originates by invagination of the colonic epithelium (a) near the cephalad end of the gonad, and grows caudally within the basement membrane of the mesonephric duct just under the coincidentally developing tubal ridge (c) early stages of paramesonephric duct development can be shown in one diagram. Soon the epithelial cells of the paramesonephric duct bud off mesenchymal cells (heavy dots) dorsally (d, e) and laterally (e, f) which separate it from the mesonephric duct. Then the tubal ridge epithelium buds off mesenchymal cells (g, h) which separate it from the paramesonephric duct. Thus, the mesenchyme surrounding the paramesonephric duct (h) is derived from the ductal and tubal ridge epithelia, both of which were previously derived from the colonic lining epithelium. (Adapted from Gruenwald [72])

Extremities upper (137-138) lower (190)
Vagina upper two-thirds (134)
Pleura (12)
Peritoneum, other than pelvic umbilicus (38, 108, 216) inguinal (27) serosal surface of ureters (37, 147) serosal surface of bladder wall (106, 116, 147)
Lymphatic endothelium in pelvic region (189)

Walker Taussig and Weller (219) have reported that decidual reactions can occur in the tissues immediately beneath the peritoneal mesothelium. This, of course, cannot be taken as proof that these tissues can change into endometrial stroma. Rather it is indicative that these tissues have retained a sensitivity to a hormonal factor similar to that which produces a decidual reaction in the endometrial stroma. This is reasonable since both peritoneal subserosa and endometrial stroma contain many cells which are descendants of the embryonic colonic lining. With this common ancestry in mind, Weller (219) credits Schiffman and Seyfert as the first to observe a similarity between frequent locations of decidual reactions and frequent locations of endometriosis.

In 1932 Sampson (183) expanded his theories sufficiently to report that cases of 'Primary Fimbrial Endometriosis' develop from the activation and differentiation of the tubal mucosa of the fimbriae into a structure resembling endometrium.

Microscopical examination of an umbilical endometrioma from an 18 year old girl was reported by Enzer. He found that the peritoneum over the tumor was composed of hyperplastic, columnar cells which dipped down toward the tumor. He also found a glands containing cells which seemed to be more tubal than endometrial in appearance.

Others (39, 148, 181) have reported the observation of glands of the tubal type epithelium side by side with glands of endometrial type of epithelium in sections of endometriosis. Likewise, various stages of development or 'maturity' of epithelium, stroma and/or gland may be observed in a single microscopic section of endometriosis, which lends credence to the metaplasia theory.

After studying the replacement of desquamated uterine epithelium in the guinea pig in 1933, Papanicolaou reported that the new epithelium forms from undifferentiated cells of the stroma just beneath. These become epithelial in character and proliferate until they completely line the

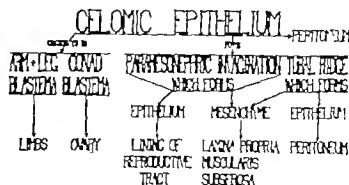


Fig. 5

denuded surface. However he attempted no corollary explanation of the regeneration of human endometrium or the formation of adenomyosis. DeSnoo went one step further into theory. He stated that the endometrium regenerated during the postpartum period and following menstruation by differentiation of undifferentiated cells which he termed *genioblasts*. He also believes that the same type of cells, ectopically located, produce endometriosis if adequately stimulated, as they are stimulated in the endometrium by hormones.

The celomic metaplasia theory permits a physiological explanation, based on embryological as well as pathological observations, for spontaneously occurring endometriosis in any portion of the body in which it has yet been reported. Therefore, it is particularly appealing to many investigators as the primary explanation for endometriosis. Unfortunately conclusive proof of the validity of this theory is now and possibly always will be, lacking.

2 *Ovarian metaplasia theory* This is a first cousin of the theory just discussed. King (108) was impressed with Sampson's early reports (174, 175, 176) concerning hemorrhagic cysts of the ovary so he made a thorough study of these lesions. By 1933, he had developed his own interpretation which may be stated as follows:

Endometrium-like hemorrhagic cysts of the ovary result from changes in cystic atretic follicles and cystic corpora lutea. His evidence for this was (1) that in the resolution of atretic follicles and corpora luteum cysts one observes hemorrhage, luteinization of parts, hyalinization of parts, and the presence of macrophages, and all these changes are evident in "endometrial-like" cysts of the ovary (2) that the epithelium found in these endometrial cysts varies from flat through cuboidal to columnar and that the cysts are usually only partially lined with epithelium, and (3) that the stroma found around the cysts varies from almost none to an abundant collection around the cysts or glandlike projections from the cysts. King then states that the implantation theory of origin of endometrial tissue in these cysts ignores the afore mentioned microscopical findings, and adds, as inferential evidence for the ovarian metaplasia theory that the absolute sterility commonly associated with endometriosis of the ovary variously reported (19, 41, 77, 107, 118) as from 20 to 70 per cent, suggests primary ovarian malfunction. Cordus had somewhat similar ideas. He interpreted his sections to show that the endometrioid epithelium was derived from either germinal epithelium or granulosa cells.

Allen (3) and Keeno and Kimbrough (107) reported that ovarian endometriosis occurred much more frequently than did endometriosis elsewhere outside the uterus in their respective series of operative patients. However Pemberton makes a point of the fact that ovaries are not involved in 13 per cent of cases. Bloom states that "the cells of ovarian stroma are probably not common fibroblasts, for they may give rise to interstitial cells and, in ovarian pregnancy to decidual cells. Scott stated the opinion that, as the distance from the ovary increases, the tendency of subperitoneal tissues to produce decidual reaction (when properly stimulated) decreases. Thus, ovarian tissue and neighboring tissues seem to be more susceptible to stimulation by the sex hormones than other tissues outside the uterus.

Novak (143) while rebutting the theory of menstrual regurgitation of endometrium, offered the opinion that in those occasional instances when endometrial particles are found within the lumina of tubes they have come from ovarian endometriosis, rather than vice versa, because of the normal direction of flow within the tubes.

Unfortunately all of these reports and studies are open to wide variance of interpretation so that proof or disproof of this theory is impossible at present. The solution of this problem awaits for their extensive microscopic study of ovarian pathology and related lesions in the pelvis.

3. *Dedifferentiation theory* This is a second cousin of the celomic metaplasia theory. Bruce and Blain, while studying the incidence of adenomyosis in a large series of uteri, stained sections with Heidenhain's modification of Mallory's aniline blue stain. They were impressed, first, with the similarity of staining qualities of the interstitial (or stromal) cells of the endometrium and the muscle cells of the myometrium. Second, they noted differences in density of the true reticular stroma, which was dense and compact in the myometrium, but fine and delicate in the endometrial tissue—whether regular or ectopic. They noted a zone of gradual transition between myometrial and endometrial cells and stated that it was impossible to determine whether the cells in this zone belonged to one or the other group. They stated that the cells of the myometrium and those of the endometrial stroma are genetically related. In 1943 they postulated that myometrial cells may undergo a process of dedifferentiation into less mature cells which possess the potentiality (1) of forming the interstitial cells of endometrial stroma, and (2) of differentiating into epithelial cells to form glands within that stroma.

Concerning the latter half of this postulate Papanicolaou demonstrated heteroplasia from stromal to epithelial cells in the endometria of guinea pigs. Also Frankl states that stromal cells are found first in endometriogenetic islands during the development of internal endometriosis, and that glands appear later—the epithelial tissue of which he describes as heterotopic.

This is an interesting theory feasible on an embryological basis but extremely difficult to prove. Theories relevant to the development of adenomyosis are discussed in the section entitled *direct extension theory*.

4. *Embryonic cell rest theory* The pelvis occasionally contains bits of abnormally placed tissue (40). Some of the earliest theories concerning the cause of endometriosis dealt with the possibility that embryonic cell rests of paramesonephric or mesonephric tissue might grow during adult life.

Paramesonephric (Muellerian) Russell (170 171) in 1888 was the first proponent of the paramesonephric cell rest theory concerning the origin of endometriosis. Ahumada and Sammartino in 1942 utilized this theory to explain the occurrence of endometriosis in the perineum. More recently Gold and Kearns reported several instances of localized macroscopic, cystic adenomyosis. They classified these as rare, but worthy of note because they considered the most likely explanation for such lesions to be that remnants of paramesonephric duct tissue had been misplaced during embryonic development.

McDonald reported a congenital anomaly of the female genital tract in a young adult. The patient had a uterus didelphys in which the left uterus, tube, and ovary were normal. However the lower end of the right uterus was not connected to the cervix or vagina, and just at the place where the connection of the lumina should have occurred there was endometriosis under the pelvic peritoneum. The most logical theory of origin for this endometriosis, in view of the associated lack of fusion of the embryonic paramesonephric ducts, would be the paramesonephric cell rest theory. However existence of thickened columnar celled serosa over the endometriosis suggested the celomic metaplasia theory of origin. The existence of multiple follicular and corpus luteum cysts (one being hemorrhagic) in the right ovary suggested the ovarian metaplasia theory of origin and the existence of a moderate hematometra suggested the possibility of the implantation theory of origin. Here in a single case, are exemplified some of the difficulties encountered in attempting to evaluate the origin of endometriosis from clinical evidence.

The most rational argument against the paramesonephric cell rest theory of endometriosis is that if paramesonephric cell rests were present, and were susceptible to stimulation by ovarian hormones in the same manner as the endometrium one would expect the most frequent occurrence of symptomatic endometriosis thereby developed in girls of late teen age or in the early twenties (early sexual life) because of ectopic menstruation. However endometriosis actually is observed most frequently in mature women of the late thirties and early forties (late sexual life) (19 41 107).

Actual proof or disproof of this theory is not possible at the present time.

Mesonephric (Wolffian) Von Recklinghausen (161, 162) in 1895 (with reference to uterine adenomyomas) and Pick (158) in 1896 (with reference to ovarian endometriosis) were the first proponents of the theory that endometriosis originates from mesonephric cell rests. Residual tissue from mesonephric ducts occasionally produces cysts or adenomas in the lateral wall of the vagina or cervix or in the broad ligament. However there is no evidence that this tissue will undergo changes which cause it to become endometrial in appearance. Probably because of the known differences in embryonic development of the mesonephric and paramesonephric ducts the mesonephric cell rest theory has not been utilized in recent years to explain endometriosis.

5. *Direct extension theory* This theory applies especially to the development of adenomyosis (internal endometriosis) but also has been applied to some instances of endometriosis in which the ectopic tissue has spread beyond the confines of the uterus (external endometriosis).

Cullen (25) demonstrated in 55 of 56 adenomyomatous uteri that the gland elements of the ectopic tissue were derived from and usually were a direct continuation of uterine endometrium. The reason why such stromatous and glandular extension is possible has been best expressed by Bloom. While discussing the histology of the female genital tract, he states, "No true muscularis mucosae and therefore no submucous layer can be distinguished. The mucous membrane is immediately surrounded by a muscular coat. Apparently the extending endometrial tissue takes the line of least resistance whether it be between muscle bundles (Cullen 28) or through lymph channels (Sampson, 181). However Meyer (132) has called attention to the destructive action of islets of endometrial stroma on myometrium with the implication that this action facilitates the extension of stroma through myometrium.

Normally there is some dipping down of the basal endometrium into the irregular inner surface of the myometrium. Any dividing line between supposedly normal, and apparently abnormal extension of endometrial tissue into the myometrium is a purely arbitrary one based on individual experience. What causes internal endometriosis to develop in some women and not in others is not known, but one theory will be discussed later (see mechanical stimulating factors).

Direct extension of endometrial tissue into the myometrium has been thoroughly studied (15, 26, 27, 28, 119) and is generally considered to be the most frequent mode of development of internal endometriosis. Sampson (181) has shown that endometrial glands may extend well beyond the confines of the uterine wall and yet maintain lumina which are continuous with the lumen of the uterus, thus producing internal and external endometriosis.

Endometriosis is rarely reported in the cervix (90). Danforth (31) has demonstrated that the cervical wall is composed primarily of tightly interwoven fibrous tissue, differing in this respect from the more loosely arranged bundles of muscle tissue which compose the uterine wall. Since extension through fibrous tissue would be more difficult than extension between muscle bundles, this anatomical difference may explain the rarity of cervical endometriosis.

A descriptive sentence concerning endocervicitis should be inserted here. This condition occurs rarely. As described by von Törzsay Kiss (206) it consists of epithelial glands of cervical type extending deeply into the fibrous tissue of the cervix. It does not respond cyclically to ovarian hormones in the manner of the endometrium, but only secretes mucus.

C. ECTOPIC ENDOMETRIUM EXTENDING FROM TISSUES OF ORIGIN THENCE TRANSPLANTED FROM SITE OF EXTENSION—COMBINATION THEORY

1. *Uterotubal endometriosis theory* In 1903 Meyer (128) wrote an article entitled "A hitherto unknown type of adenomyoma of the uterus, in which he described an instance of endometriosis in a laparotomy scar following an operation for salpingectomy and ventrofixation. In the 1920's Sampson (181, 182, 185) studied a series of similar postsalpingectomy adenomyomatous lesions of abdominal scars which he named "postsalpingectomy endosalpingiosis. He found this proliferation of endosalpingian intramural glands in 112 of 147 of the tubal stumps (75%). He also found endosalpingiosis (tubal adenomyosis) in 16 of 200 tubes not operated on (8%) Sampson (185)

also studied the pathogenesis in 17 instances of laparotomy scar endometriosis, all but one of which followed salpingectomy. In 12 of these he injected dyed gelatin into the lumen of the uterus before removal and in 8 instances (66%) he was able to demonstrate the gelatin in the endometriosis of the abdominal scar. In 1 instance the endometrial tract from the tubal stump was 7 cm. long and endometrial sprouts had extended 4 cm. farther through the scar to the skin—a total extension of endometrial glands of 11 cm. beyond the tubal stump.

In 1930 Everett studied the function of the interstitial portion of the tubes with the cornua of the uterus in patients who had no previous surgery. Of 122 tubes studied, 37 (30.3%) showed tubal adenomyosis classified as follows:

	Tubal type	Half and half	Cornu type
Epithelium	20	4	4
Endometrial stroma or stromalike tissue		4	4

Therefore he stated that an operative trauma with a transplantation is not necessary in the region of the uterine cornu.

In the 1930's, Philipp and Huber (95, 154, 155, 156, 157) made a careful study of the tubes and uteri from 83 patients who had had pelvic or abdominal endometriosis. They found that 19 of these had endometrial extension from the cornal portion of the uterus into the tubes—14 bilaterally—and that 9 had actual endometrial polyps of the tubes—3 bilaterally. Using hysterosalpingography they studied tubal patency and concluded that, excluding (1) premenstrual closure and (2) closure by submucous fibroids, all closure of the interstitial portion of the tube is due to tubal endometriosis.

They theorized that endometriosis extends outward from the cornal portion of the uterus to the interstitial portion of the tube, causing tubal adenomyosis. From this, bits of healthy endometrial tissue may (1) break off pass out of the tube, and implant on the peritoneum or (2) break off from the serosal surface of the tube and implant elsewhere in the peritoneal cavity.

Philipp and Huber (157) concluded from their studies that in the patients who suffered abdominal endometriosis following tubal endometriosis the condition occurred in four-fifths of them as a result of retrograde tubal migration and implantation on the peritoneum of healthy bits of endometrium, and in one fifth by direct extension through the tubal wall opening out into the peritoneal cavity.

Weyeneth first pointed out that unilateral tubal adenomyosis is frequently accompanied by homologous uterine adenomyosis. For this reason, and because adenomyosis occurs more frequently in association with anomalies of the tubes than in association with previous inflammation of the tubes, Work and Broders consider tubal adenomyosis to be of congenital origin. They also noted that it sometimes occurred unilaterally in patients who had had bilateral salpingitis, and consequently they doubted that inflammation was of primary etiologic importance. In this connection Yin has recently reported 2 cases of adenomyosis uteri with associated congenital uterine anomalies.

Schenken and Burns studied and classified 339 isthmic nodules from the tubes of 208 patients. They concluded that approximately 70 per cent were adenomyomatous lesions of which 67 per cent contained endometrial tissue and the remainder endosalpingian tissue. Rintelen studied the incidence of tubal endometriosis in 513 women who had had no pathological symptoms clinically referable to the uterus or tubes, but upon whom sterilization operations were performed. He compiled the following surprising statistics:

Ages	Number	Cases of Tubal Endometriosis	Percentage of cases in Group
3-20	130	6	4.6
21-30	113	9	7.9
31-40	54	6	11.1
41-45	6	0	0

Work and Broders observed that adenomyosis tends to occur most commonly at the tubouterine junction and that its incidence seems to diminish caudad and cranial from this region. These investigators and others (139-103) have considered the tubouterine junction to be a transitional area where interchange between tubal and uterine mucosal characteristics are the rule rather than the exception and where glandular tissue is more likely than elsewhere to tunnel into the muscularis to cause a hypertrophic response thereof and result in adenomyosis.

Other investigators (18-112-140-173-186) have noted a correlation between the occurrence of tubal adenomyosis and the occurrence of tubal pregnancies. Lash (112) has observed a human ovum within a small tubule in a patient who had tubal adenomyosis. Whether this ovum entered the tubule from the tubal end or through a possible abdominal ostium is not known. Concerning the coincidence of tubal adenomyosis and tubal pregnancy Schaulfer and Wyma report an operation in which they found an interstitial pregnancy in

one tube surrounded by a large decidual reaction and adenomyosis of the interstitial portion of the other tube, also containing a definite decidual reaction. Casler (18) reports that 6 years after removing a right tubal pregnancy and a left cystic ovary he had to operate again on the same patient, this time for removal of another tubal pregnancy within the stump of the right tube. Sammarino made serial sections of 100 tubal pregnancies. In 16 of the tubes he discovered endometriosis. Still other investigators (34-124) have reported coincident occurrence of ovarian pregnancies and ovarian endometriosis in the same ovary and have suggested that ectopic endometrium is an important factor in ectopic implantation of fertilized ova.

Obviously most of these observations are subject to varied interpretation. However the interpretations presented by various investigators seem to indicate that proliferative phenomena occur in the region of the tubouterine junction rather frequently and that the occurrence of endometriosis in conjunction with these phenomena is considerably greater than heretofore suspected.

Probably the correct attitude toward this particular subject was expressed by McKelvey in his review of the five papers by Philipp and Huber. He wrote, "This work is an interesting and perhaps important contribution. While the original (articles) contain much repetition and too much speculation they should certainly be carefully read. The work would seem to justify confirmatory studies."

More specifically it seems fairly well established that adenomyosis occurs with surprising frequency at the tubouterine junction that the epithelium thereof may be uterine type, tubal type or both and may or may not be surrounded by stroma and that the glands thereof may extend through the musculature to the serosa and in some cases, well beyond. Still in the realm of theory, however are the suggestions that bits of healthy tissue break off either from the mucosal surface of adenomyotic areas to migrate out of the tubes, or from the serosal surface of adenomyotic areas to travel elsewhere in the pelvis—in either instance to implant and produce external endometriosis.

D. MALIGNANT CHANGES

Malignant changes within ectopic endometrial lesions are not common.

1. *Carcinomatous change* Hosai and Meeker (94) reported carcinomatous changes within endometriosis of the transverse colon. Other men (1,8) have observed rare carcinomatous changes in ectopic endometrial tissue.

2 *Sarcomatous change* A number of authors (17 63 84 135 154) have described an unusual type of uterine endometriosis" which consists almost entirely of stroma. Miller and Tennent described it grossly as a yellow rubbery substance and said that it tends to grow down lymphatics, leaving the walls of the lymphatics dilated but intact. There is a heavy reticulum between the cells, and the blood vessel walls are markedly hypertrophied. TeLande suggests that the name "stromatosis" would be most descriptive of this particular condition. Philipp and Huber mention the hyalolytic power (154) of this type of endometrial change. They mention 1 case and Goodall (63) mentions 2 such cases which subsequently developed sarcoma within this stromal endometriosis, reportedly checked before and after with microscopical sections.

II. FACTORS WHICH MAY STIMULATE THE DEVELOPMENT OF ENDOMETRIOSIS

This subject is for the most part within the realm of theories. First mechanical, then inflammatory and finally hormonal factors will be considered.

A. MECHANICAL FACTORS

1 *Surgery curettage insufflation.* Mechanical transplantation of endometrial tissue during ispyrotomy delivery and curettage has already been considered (see mechanical transplantation theory). There is no doubt that healthy proliferative endometrium can be transplanted, and that it frequently will grow and function in the new site. To study the effect of curettage, Watkins (214) operated upon 8 patients immediately after curettage. In all 8 patients he observed from 5 to 60 c.c. of blood in the cul-de-sac and also blood dripping from the fimbriated ends of the tubes.

Not previously mentioned herein is the theory often suggested but never substantiated, that curettage may instigate the development of adenomyosis uteri.

Nor has the possible role of tubal insufflation been considered to any extent. Spirito forced air through the uteri and tubes of rabbits and guinea pigs on 10 successive days. One hundred and twenty-four days later at autopsy he observed endometrial cysts implanted on the peritoneum, identical in microappearance with those which resulted from surgical transplantation of endometrium in the same species. Consequently he reasoned that the Rubin test may be an instigating factor in external endometriosis, and he pointed out that endometriosis is reported most frequently from the United States and Germany countries

which also report most frequent use of the Rubin test. It should be mentioned that in all except severe cases, endometriosis is observed most frequently by those operators who have trained themselves to recognize it grossly (51 52, 178, 179). Therefore, it seems likely that the increased incidence of reports of endometriosis from the United States and Germany derives from increased interest in the subject and careful observation of operative patients in these countries rather than from other factors. It is conceivable, however that development of a high intrauterine pressure to overcome obstruction during a Rubin test, followed by a sudden gushing of gas out of the tube, with the release of obstruction might be accompanied by transportation of endometrial particles through the tubal lumen, especially if tubal adenomyosis is present.

The physiology and anatomy of the tubes were discussed previously herein (see Implantation theory). Concerning their pathology Goodall (61) considered "praeternatural patulousness of the Fallopian tubes to be a menace to the peritoneal cavity." He cited the histories of several patients who had had pelvic peritonitis in whom he was able to pass gas through the tubes at 20 mm. Hg. and he theorized that the patulousness of the tubes facilitated retrograde passage of infection. However he did not attempt to apply this "praeternatural patulousness" to the retrograde menstruation theory of endometriosis, and it is pertinent to point out that these tests were not made at the time of menstruation when tubes are most resistant to retrograde flow (166).

2 *Pathological anatomy of the genital canal.* Uterine retrodisplacement. It is the opinion of many authors (31 41 111 152 214, 215, 216) that retrodisplacement of the uterus predisposes to retrograde menstruation. Watkins (214, 215) operated upon 8 women who had retrodisplaced uteri during menstruation, and observed blood dripping from the tubes in all 8. Examination of the blood in the cul-de-sac was reported as showing red blood cells, leucocytes, and endometrial cells. Upon 11 other patients with retrodisplaced uteri Watkins used the following procedure immediately prior to operation with a 2-way cannula he sucked 1 per cent methylene blue into the uteri under negative pressure. About 5 c.c. of the solution were retained in each instance. At operation he observed that 5 patients had closed tubes, 4 patients with open tubes had mild to moderate staining of the fluid in the cul-de-sac, 1 patient, with open tubes, had no staining of the fluid in the cul-de-sac and in 1 patient with large myomas the dye was not retained in the uterine cavity

Watkins also made several unsuccessful attempts to instill dye into upright uterus.

These observations were made with the patient lying on her back. With the body in such a position gravity favors the retrograde (transtubal) flow of intrauterine fluid. However if the retrodisplacement is not of third degree and the patient is in any other standard position i.e. standing, sitting or lying prone gravity is more likely to favor the normal flow of intrauterine fluid through the cervical canal, provided no cervical obstruction exists, for the cervix will then be lower than the uterine lumen.

Polak and Stacy determined that approximately 20 per cent of all women have retrodisplaced uterus and of these only about one-sixth have dysmenorrhea (199). Fallas and Rosenblum report some degree of uterine retrodisplacement in 52.6 per cent of 260 patients with endometriosis, but Haydon reports uterine retrodisplacement in only 14 per cent of 569, and Payne in only 7 per cent of 307 patients with this condition. (It should be noted here that some observers think that dense adhesions between the posterior wall of the uterus and endometrotic lesions in the posterior cul-de-sac actually produce uterine retrodisplacement).

From these sundry observations it seems likely that a sufficient degree of primary uterine retrodisplacement may facilitate the flow of intrauterine fluid out through the tubes, provided the subject be in supine position. More than this cannot be concluded.

Cervical Obstruction. Watkins (216) pointed out that sharp antelexion or retroflexion of the body of the uterus on the cervix would cause constriction of the cervical lumen. Curtis (29, 30) has repeatedly demonstrated that cervical strictures may follow endocervicitis or cervical instrumentation (especially cautery) or less frequently a tumor encroaching on the cervical lumen. There are numerous reports of instances of congenital atresia of the cervix or vagina (8, 46, 55, 97). If severe enough many of these lesions will obstruct normal outflow through the cervix and vagina, and tend to cause retrograde flow through the tubes. However in the last mentioned congenital atresias of the lower genital canal, it is remarkable how much dilatation of the vagina takes place before hematometra develops, how much dilatation of the cervix and uterus takes place before hematosalpinx develops, and how much of the latter occurs before a chocolate cyst involving the fimbria and ovary develops. This seems to indicate that retrograde menstruation is not a simple and easy process. Bernstein and Walter report 10 instances of congenital atresia of the lower genital

canal among which 2 instances of pelvic endometriosis were observed. They also report 9 instances of acquired atresia of the lower genital canal among which 2 instances of adenomyosis and 1 instance of pelvic endometriosis were observed—totaling 5 or 26.3 per cent, of the 19 operative cases. Holmes (92) reports the incidence of endometriosis among all gynecological patients who submit to abdominal operations as ranging from 21.8 per cent (Sampson) to 26.0 per cent (Holmes) to 32.0 per cent (Meigs). These figures do not indicate an increased incidence of endometriosis among the 19 patients who had congenital or acquired atresias of the lower genital canal despite frequent hematocolpos, hematometra and hematosalpinx.

3. Pregnancy. Meigs (126) reported that mild adenomyosis is more common in women who have had multiple pregnancies, according to statistics at the Massachusetts General Hospital. Scott reported 6 instances of adenomyosis and coincident spontaneous rupture of the uterus during pregnancy. Sackett reported the history of a woman whose uterus contracted well during her first cesarean section but would not contract at all during her second section, 2½ years later. Hysterectomy was performed and marked adenomyosis with decidual reaction therein was discovered. Frankl (48) states that symptomatic internal endometriosis is most commonly found in the age group from 41 to 50 whereas external endometriosis is most commonly found during the preceding decade. Bloom writes: "In pregnancy the connective tissue of the uterus becomes more abundant and succulent, which causes considerable loosening of coherence between muscle bundles."

However if pregnancy is a factor in the development of adenomyosis, it still is not known on what basis, mechanical or hormonal or both.

B INFLAMMATORY FACTORS

Frankl (48) has stated that there is very definite evidence of inflammation around external endometriosis. Sampson (178, 179) theorized that regurgitation of menstrual blood is especially irritating to the pelvic peritoneum stimulating in it an inflammatory condition which facilitates implantation of endometrial particles thereon. Meyer (132) theorized that following pelvic inflammation the healing process runs riot causing metaplasia of the epithelium and subepithelial cells into endometrial like tissues. Apparently regardless of one's theories concerning histogenesis, a number of investigators have postulated the intercession of an inflammatory process as abetting the development of endometriosis.

It is a well known fact that there are inflammatory changes in and around active endometrial lesions. However these changes are a local response to a semi invasive tissue in a foreign location, aggravated periodically by the menstrual cycle. Therefore, it seems like placing the cart before the horse to say that these inflammatory changes cause, or are a factor in causing the development of endometriosis.

C. HORMONAL FACTORS

Here the flight of theories approaches a zenith. Conversely although inferential evidence is abundant, one can plumb the depths, yet seldom find a solid foundation of fact.

A number of authors (3, 35 125 144 193 222) have written that the primary factor initiating the development of endometriosis is hormonal in nature. As early as 1931 Novak (144) theorized, "The sensitizing influence must be of physiological nature, probably bound up with the internal secretion of the female gonads." This theory will be discussed under several subheadings.

1 *Response of ectopic endometrium to ovarian hormones* The ability of active endometrial lesions to respond to ovarian hormones in a manner similar to the response of uterine endometrium has been demonstrated histologically by several authors (59 64, 149) Goldstone and Fogelson's photomicrographs, taken from endometrial lesions of the rectovaginal septum, not only show all phases (proliferative, secretory menstrual) of endometrial response to ovarian hormones but also show a gland with cells of tubal type epithelium.

Faulkner and Reimenschneider report the case of a "postmenopausal" woman whose rectovaginal endometriosis was reactivated by therapy with stilbestrol (1 mgm. per day for 15 days). She suffered rectal bleeding sufficient to cause a drop in the red blood count to 2,570,000. The bleeding stopped when the stilbestrol was discontinued.

Weinstein *et al* and Hobbs and Bortnick (88, 89) demonstrated that endometrial transplants in rabbits responded to injections of estrogens in the same manner as the uterine endometrium, and the latter authors also noted decidual reactions in endometrial transplants of pregnant animals. While transplanting endometrial tissue in rabbits, Neumann found that ectopic endometrial cysts would develop in his normal rabbits, but none were found in animals previously castrated. However Jacobson (99) found endometrial cysts which were developing in rabbits which he castrated at the time of the transplantation but the cyst walls were much thinner than were those which developed in normal rabbits.

It must be concluded that ectopic endometrial tissues and regular endometrium respond to hormones in a similar manner. It is argued that, if the ovarian hormones influence the development of intrauterine endometrium, it is reasonable to theorize that the same hormones would occasionally influence the development of embryonically related cells outside the uterine endometrium in such a manner that ectopic endometrium might result. There is no proof that this is impossible. However the ability to stimulate already existing tissue to physiological activity is not the same nor even necessarily related to the ability to initiate the development of new tissue.

2 *Relative tissue sensitivity to hormonal stimulation* (a) Goodall (63) and others have indicated that the lesions of endometriosis which do not show cyclic activity in conjunction with the uterine endometrium are derived from the so-called insensitive basal layer while the more active endometriotic lesions are derived from the superficial two-thirds of the endometrium which responds to hormonal stimuli by menstruating. However Hartman excised the endometrium from monkeys as completely as possible, certainly leaving behind only a few fragments of the basal layer and he found completely regenerated, functional endometrium in these monkeys from 14 to 20 days after operation. This was repeated 4 times in one animal. Many of the animals so treated subsequently became pregnant, one animal 3 times, and delivered normal fetuses. Certainly in these monkeys cells derived from basal tissue responded normally to ovarian hormones.

A more likely explanation for variation in activity of ectopic endometrium is available. Bar telmez (6 7) studied human uteri removed at the time of menstruation and discovered that different areas in the superficial endometrium of a single uterus responded differently both in time and degree. Concerning ectopic endometrial tissue, the corollary explanation is obvious, although the reason for differing sensitivity is not known.

Ranging further into theory if ectopic endometrium evolves by a process of metaplasia from peritoneal and subserosal cells, at any one time there must be several stages of maturity represented in different lesions. Theoretically the most differentiated tissue would respond most readily to hormonal stimulation and vice versa.

(b) Goodall (63) mentions that he frequently finds the pelvic peritoneum perceptibly thicker in endometriotic patients than in others. He calls this pelvic sclerosis, differentiates it from scar tissue, and says it is due to the same hormonal stimuli which facilitate the development of endo-

metrosis If there is any basis for the suggestions of Novak (145) and Allen (3) that endometriosis is a manifestation of cellular metaplasia following hormonal stimuli, then surely the serosa and subserosa of the pelvic and lower abdominal peritoneum should show more susceptibility to the ovarian hormones than should more distant tissues of the body because of close embryonic relationship to endometrial tissue—as shown by Gruenwald (67 68 69 70, 71). In this connection Scott points out that as the distance from the ovary increases, the tendency for subperitoneal tissues to produce a decidual reaction decreases and Novak (144) notes that the distribution of decidual plaques is almost identical with that of endometriosis. As noted above these suggestions are all of an inferential nature.

3 Age incidence The age frequency graph (Fig 6) adapted from Fallas and Rosenblum's statistics demonstrates the usual ages at which patients suffering from external or internal endometriosis come to operation. Statistics of other investigators (1 106 151) agree essentially with the age incidence depicted.

Although patients suffering from endometriosis have come to operation most frequently during the fourth and fifth decades of life, Fallon (42) has recently reported that 4 per cent of the last 225 endometriosis patients upon whom he operated have been teen age girls. Many of these gave histories of increasing dysmenorrhea. In the remainder of the endometriosis was discovered at operation. In a routine examination of supposedly normal tubes, Runtelen found tubal endometriosis in 4.61 per cent of 130 teen age girls. Holmes (92) suggests that increasing dysmenorrhea and pelvic pain occurring in the second decade of life may often represent symptoms of the early stages of endometriosis more severe symptoms leading to operation in the third and fourth decades represent later stages of the disease.

Obviously endometriosis occurs during the sexually active period of life, starting after puberty and stopping in most instances (65 193) at the menopause. It is perhaps too easy to assume then, that those hormonal factors which produce sexual maturity in women also may produce endometriosis. Attention should again be called to the fact that stimulation of growth of an existing structure is not the same as neogenesis of that structure.

4 Infertility Gardner (52) writes, "Often endometriosis is first recognized when a search is being made for a woman's failure to conceive." Numerous authors (1 19 21 36 41 43 52 107 109 118 194 195) agree that the percentage of

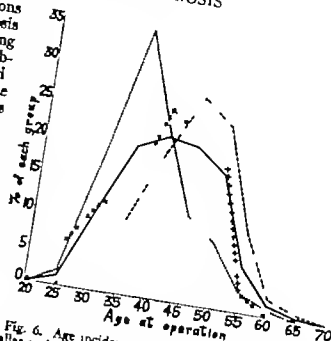


Fig. 6. Age incidence of endometriosis—adapted from Fallas and Rosenblum (41). Patients in whom only external endometriosis was found came to operation most frequently at age 35. Internal endometriosis, at age 45. Both combined in same patients, at age 40. The majority of all endometriosis patients come to operation between the ages of 35 and 50. External endometriosis 95 cases, in patient (++++). 129 cases both types in same patient (++++). 36 cases all cases of endometriosis—260 cases.

infertility among these patients is much higher than normal. Absolute sterility is variously estimated at from 20 to 70 per cent. Likewise sterility at from 50 to 90 per cent. Likewise authors are somewhat dubious about the ability of these patients to conceive even after corrective surgery. Lock and Meyers summarized the reports of various operators (21 77 107 152 209). Among these, by far the best results were obtained by Turunen (209). Of 200 endometriosis-sterility patients he operated upon, about 32 per cent were able to conceive postoperatively, however no record is made of the number of living term babies which accrued.

Again the question of precedence arises—the cart, or the horse? Is this infertility caused by the endometriosis, per se, or is it caused by the same factors which initiate the development of endometriosis? The answer is not known but the fact that this infertility often is noted early in sexual life, preceding rather than following the known development of endometriosis (43) favors the latter explanation and King (108) uses this as an argument in favor of his ovarian metaplasia theory. Lack of ovulation is most frequently given as the cause of sterility in these patients but no study has been undertaken to prove or disprove this statement.

No one knows how many women with endometriosis have become pregnant because no one knows how many women have mild, more or less asymptomatic endometriosis. Therefore, statistics correlating infertility and endometriosis are only significant with relation to those more severe cases which come to surgery and which are proved pathologically.

5 *Coincident pelvic pathology* Many authors (1 3 36 41 47 63 77 95 109 117 136 152 195, 222) report that the incidence of fibromyoma of the uterus is high among patients who have endometriosis, ranging from 22 to 73 per cent. (Curtis [31] records that according to autopsy reports 'one out of every five women of mature years has uterine myomata' [30%], but he mentions that many of these are too minute to be clinically significant.) Many authors (41 47, 77 103 117 136 222) also report an increased incidence of endometrial hyperplasia, from 10 to 71%, of endometrial polyps, from 8 to 14% and of follicular cysts, from 14 to 22%, among endometriosis patients who have been operated on. From these and similar statistics (196) some writers (35 103 222) have inferred that endometriosis is but one of several manifestations of hyperestrinism displayed by some women. However Sturgis points out that the diagnosis of endometriosis was made in only 15.7 per cent of 51 patients who had endometriosis. The remaining 84.3 per cent of the patients were operated upon for other pelvic disease, such as myoma and ovarian cysts at which operations the endometriosis was incidentally discovered. Other writers (21 41 43 51 52) have remarked upon the infrequency with which a pre-operative diagnosis of endometriosis can be made with any degree of certainty. Thus, it seems likely that the statistical correlations noted may be more apparent than real, since in many instances the patients were probably operated upon because of symptoms and findings produced by their myomas, ovarian cysts, uterine polyps, or endometrial hyperplasia, with endometriosis as an incidental finding at operation. There may be as many women without myomas, but with endometriosis, who have no symptoms. Therefore, these patients would not be operated upon, and, thus, their endometriosis would not be discovered.

Consequently no conclusion can be drawn from the relative statistics listed concerning the etiology of endometriosis.

6 *Cyclic stimulation theory* Meigs (125 126) noted that whereas endometriosis was observed in from 28 to 50 per cent of private gynecological operative patients, it was observed in from only 5 to 8 per cent of charity gynecological operative

patients. He observed that the most fundamental difference between these two groups was the tendency toward later marriage and less frequent pregnancies among the private patients. He theorized that the resultant, cyclic, hormonal stimulation, uninterrupted by pregnancy and lactation during the first 17 to 27 menstrual years in many of his cases, was an important factor in the development of endometriosis. He postulated that earlier marriages and less contraception would protect somewhat against the development of endometriosis by insuring earlier and repeated pregnancies followed by lactation. In this connection, Fallon *et al* (43) noted that only 1 of 200 patients with endometriosis had been pregnant within 5 years prior to their operation.

This is an interesting theory with many ramifications, both medical and sociological. However, it does seem to ignore the relatively tremendous concentrations of hormones which are produced during pregnancy. Proof or disproof of this theory may be possible after another generation of observation and correlation.

III. SUMMARY

It has been well established that endometrial tissue will extend outward from its normal location, either between muscle bundles or through lymphatics. This extension may on occasion proceed beyond the confines of the uterus. There is some evidence that the uterotubal junction is the most frequent site of such activity.

Likewise, particles of healthy endometrium can be surgically transplanted, and will grow in ectopic sites. Theoretically such healthy endometrial particles may (1) break off from the serosal surface of direct extension endometriosis and spontaneously transplant themselves to some other serosal surface, or (2) break off from uterotubal adenomyosis, either spontaneously or as a result of intrauterine trauma and may travel out through the tube spontaneously or more likely after intrauterine trauma, to implant on the peritoneum.

Theories involving retrograde menstruation are still held in doubt because of the inability to present conclusive proof that the viability of menstrually discharged, endometrial particles is adequate to support implantation.

The theory that all derivatives of the embryonic coelomic lining retain the potential ability to develop endometrial-like tissue by a process of metaplasia when properly stimulated has the following advantages:

- 1 It is based on known embryology
- 2 It permits a physiological explanation for the development of endometriosis.

IV APPENDIX

A OUTLINE HISTORY OF LITERATURE CONCERNING ENDOMETRIOSIS CHRONOLOGICALLY ARRANGED

Date	Name	Ref. No	Contribution	Date	Name	Ref. N	Contribution
1860	Rokitansky von	65	First known record concerning endometriosis described an adenoma	1909	Goddard	57	First to report endometriosis of the umbilicus as such
1870	Waldyer	912	Suggested that such lesions might originate from germinal epithelium of ovary	1910	Meyer	3	Enlarged on the serosal metaplasia theory suggesting local inflammation as an exciting factor
1887	Walker	13	Reported ectopic decidual reaction of pelvic peritoneum coincident with uterine pregnancy	1921	Sampson	74, 75, 76	Theorized that retrograde menstruation of bits of endometrium through the tubes was followed by implantation and growth of endometriosis on ovaries and pelvic peritoneum
1888	Russell	170, 17	First to report endometrial tissue in ovaries theorized origin from misplaced paramesonephric tissue	1924	Hallam	72, 73	Theorized that endometrial tissue metastasized by way of lymphatics
1893	Recklinghausen, von	16, 162	Theorized that origin of adenomyoma is from mesonephric duct cell rests	1925	Kerck	100	First to report endometriosis of the bladder
1896	Pick	58, 159	Theorized that origin of ovarian endometriosis is from mesonephric duct cell rests	1926	Novak	43	Suggested that some endocrine factor may induce serosal metaplasia
1896	Isenack	96	Suggested that the endometrial elements of adenomyoma may develop from the peritoneal surface of the uterus	1927	Schiller	89	Suggested that endothelial and other cells of mesothelial origin might undergo heteroplasia to form endometriosis
1896	Cullen	24	First to report adenomyoma of the round ligament, as such Round ligament tumor reported by 5 other men (Coulson 1899, Eichenbaum 1899, Leopold 1900, Roustan 1904, and Martin 1905 may have been adenomyomas)	1931	Kling	68	Theorized that ovarian endometriosis resulted from metaplasia within uterine follicles and corpus luteum cysts
1897	Ries	103	First to report endometrial tissue in the lymphatics	1936-39	McEpp and Riber	54, 55, 56, 157	Theorized that tubal endometriosis was the first step in the development of pelvic endometriosis
1898	Lockstaedt	9	Demonstrated continuity between endometriosis and subserosal endometriosis	1936-39	Navratil	37, 38	Reported endometriosis of the arm, suggesting venous metastasis
1901	Meyer	128	First to report endometriosis in laparotomy scar	1943	Brines and Blain		Theorized that adenomyoma resulted from dedifferentiation of myometrial cells to embryonic forms and redifferentiation to endometrial cell
1908	Meyer	130	First to report intestinal endometrial adenomas	1947-48	Giesen and	67, 68, 69, 70, 71	Demonstrated, microscopically the embryological basis for the reticulo-metaplasia theory
1908	C. Dea	5	Demonstrated that tertiary adenomyoma can occur by direct extension of endometriosis into myometrium				

3 Possible transitional stages have been observed microscopically

4 Spontaneously occurring endometriosis in all known locations can be explained on the basis of this theory

The theory of lymphatic metastasis of endometrial particles is possible but its scope is limited. All lymphatic phenomena thus far observed concerning endometriosis can be explained on the

basis of (1) direct extension through lymphatic spaces, or (2) metaplasia within the lymphatic system.

The theory of venous metastasis of endometrial particles to produce endometriosis in distant parts of the body can be proved only by microscopic observation of an endometrial tumor in lung tissue.

The paramesonephric cell rest theory is feasible but is not at present susceptible to proof

The factors which may stimulate the development of endometriosis are more theoretical than the theories concerning the histogenesis thereof. Suffice it to say that (1) some cases of endometriosis may be induced by pelvic operative or diagnostic procedures (2) it has not been determined whether endometriosis occurs as a consequence of pelvic inflammation or vice versa (3) endometriosis occurs during the sexually active period of a woman's life usually regressing spontaneously after the menopause whether spontaneous or artificial and (4) infertility is higher than average among patients suffering from endometriosis. These last two observations indicate that the ovarian hormones are related to endometriosis. Whether the relationship is that of an initial stimulating force or simply that of an incidental physiological function is not known.

This subject like so many subjects in medicine is weighted with many worthy thoughts, but few golden truths. One excellent consequence of the widespread interest in endometriosis is that this condition is being recognized more frequently now than previously at the operating table. Further knowledge of its etiology may facilitate proper diagnosis earlier in the disease than is now possible.

The writer wishes to acknowledge most gratefully the expert recommendations, in suitable and not suitable matters, of Louis Dr. R. Greene.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Ocular Involvement in Rats on Diets Deficient in Amino Acids: I. Tryptophan. ARMANDO FERRARO, LEON ROIZIN, ISAACOW GIVNER, and MORGAN WORTHY. *Arch. Ophth.*, Chic., 1947 38 331

During the past 4 years the authors have been engaged in a study of the effects of various amino acid-deficient diets on the growth, development, and morphology of various body tissues and organs and on the endocrine glands and nervous system in rats. Up to the present they have observed ocular involvement with diets deficient in tryptophan and valine. The experiments confirm, extend, and complete some of the observations made by earlier workers following their experiments with rats maintained on tryptophan-deficient diets.

In the present article the authors pay particular attention to the development and the histologic character of the cataractous changes in the lens associated with this deficiency.

The ocular changes, in order of their appearance may be described thus:

1. In younger animals there appeared spectacle eyes, conjunctivitis, superficial vascularization of the cornea and occasionally cataractous changes in the lens. This group of animals did not resist for long on the deficient diet and generally died before presenting specific symptoms of tryptophan deficiency noticeable to a greater degree in the next group.

2. In rats of greater development, spectacle eyes were apparent at times, but less frequently, and in a less pronounced degree than in younger group. However, corneal vascularization and particularly various degrees of cataractous changes in the lens were more constant.

3. In a third group comprising adult rats weighing 300 gm, spectacle eyes and conjunctivitis were noted only occasionally, whereas vascularization of the cornea was more commonly observed.

The authors believe, therefore, that the development of cataractous changes in the lens occurred immediately before the rats reached the adult stage. They consider it an established fact that tryptophan is able to prevent, improve and cure the general clinical as well as some of the ocular symptoms produced experimentally by tryptophan-deficient diets. These changes are of two types: (1) the earlier ones characterized chiefly by water splitting of the lens fibers and vacuolation, changes which the experiments have established to be reversible under tryptophan treatment, and (2) the more advanced ones leading to disorganization of the structure of the lens, changes which seem to be irreversible.

J. WOODHULL OVERTON, M.D.

Ocular Changes in Rats on Diets Deficient in Amino Acids: II. Corneal Dystrophy Due to Valine Deficiency. ARMANDO FERRARO, LEON ROIZIN, ISAACOW GIVNER, and MORGAN WORTHY. *Arch. Ophth.*, Chic., 1947 38 342

It has been established that of the 22 most important amino acids, 10 are absolutely essential to growing animals and 8 are necessary for the maintenance of the nitrogen equilibrium in adult man.

In this preliminary communication the authors report their observations on rats reared on a valine deficient diet. They observed that changes develop in the cornea in addition to various changes and structural alterations in other organs which are still the subject of microscopic studies. The corneal changes seem to be the result of edema and progressive degeneration leading gradually to keratinization and disorganization of the epithelial structure of the cornea. These changes are generally encountered in the interpalpebral space. In addition pronounced deep vascularization of the cornea is observed. Slight changes in the lens chiefly vacuolation of the cortex are only occasionally noted.

The structural changes in the eye appear to be reversible. The corneal changes appear to be the more prominent feature of the ocular involvement. The authors feel justified in naming the corneal change nutritional corneal dystrophy.

J. WOODHULL OVERTON, M.D.

Intraocular Foreign Bodies. GEORGE M. HALE, J. *Am. J. Surg.* 1947 335 894.

The author discusses intraocular foreign bodies. He points out that the toxicity of foreign bodies for ocular tissues varies according to their composition. Gold, silver and platinum are well tolerated. Iron and copper oxidize rapidly and result in siderosis bulbi or chalcosis. Lead and zinc are somewhat irritating. Glass, aluminum and plastics are practically inert.

Hale concludes that the presence of an intraocular foreign body in the eye is always a serious matter, the degree of seriousness depending on its location. Immediate extraction of the foreign body is not always necessary. Accurate localization is most essential. Roentgenologic localization should be supplemented with the use of the Berman or Carney locator. The technique of extraction depends on the composition and location of the foreign body and on the condition of the eye. Magnet extraction is preferable but surgical procedures are required for the removal of nonmagnetic foreign bodies. Emergency enucleation of the eyeball is seldom justified.

Chemotherapeutic substances, antibiotics and foreign protein should be administered routinely in

the treatment of all perforating wounds. The regimen found most effective was the administration of penicillin in from 40,000 to 50,000 Oxford unit dosages as soon after injury as possible which were continued until 2,500,000 units had been given.

JOHN ZUCKERMAN M.D.

Use of Air Injections Into Tenon's Capsule for Localization of Orbital Foreign Bodies. B. VJAM. PETERMAN. *Arch Ophthalmol* Chic 61:7 15 660

The author believes that the injection of air into a non-aqueous capsule may be of considerable diagnostic value in the localization of orbital foreign bodies by outlining the contour of the globe and providing a basis for judging their relative positions. From 6 to 10 cubic centimeters of air injected into a non-aqueous capsule, either in the upper or lower quadrant, can displace the position of the known foreign body sufficiently to push the globe forward. Roentgenograms taken on angles or stereoscopic film, which take on shadows or vessels if the foreign body is metallic, it will be separated from the globe by the air even if the foreign body is not metallic. The technique is described in the preceding paper. The use of a large dose of roentgen radiation in cases in which metal is present is not indicated. R. H. LAWSON, M.D.

Tenotomy 1st Superior Obliq for Hyperopia
Preliminary Report F N D 1 Tech
Opth Chrc 047 15 05

The author describes a surgical procedure for the cure of hypertropia associated with overaction of the superior oblique muscle. Overaction of this superior oblique muscle occurs rarely as a primary lesion but generally is due to a weakening of the homolateral inferior oblique muscle or of the contralateral inferior rectus muscle. These patients experience ocular discomfort, headaches, a rural diplopia, and difficulty in reading. It is characterized by head tilting and by vertical deviation which increases in adduction and in the lower temporal fields. If the vertical deviation is 5 prism diopters or less, prisms or fusion exercises may be sufficient. Operative treatment is indicated if symptoms persist. As a general rule all surgical procedures in the vertically acting extraocular muscles are directed toward (1) strengthening the weak muscle, (2) weakening the direct antagonists, or (3) weakening the yoke muscle. Tenotomy or tenectomy of the superior oblique muscle had never been performed previously to relieve hypertropia in a patient with overaction of the oblique muscles. Most ophthalmic surgeons have questioned its advisability. The author believes it is a safe, simple, satisfactory procedure and that it should be performed whenever the muscle is overactive and the symptoms of the hypertropia cannot be relieved by nonoperative means. In cases of paralysis of the third nerve and in cases of so-called paralysis of elevation, the superior oblique muscle should be tenectomized.

Anatomically the sheath of the tendon of the superior oblique muscle has many attachments to

the adjacent muscles and surrounding tissue. There are also many delicate areolar tissue fibrillae connecting the tendon to its sheath. It is believed these attachments allow the muscle tendon to be cut with only a weakening of its action and not a paralysis. The surgical procedure can be done under either a local or general anesthetic. The conjunctiva and Tenon's capsule are incised in the superior nasal fornix and the tissue between Tenon's capsule and the sclera is undermined posteriorly. A muscle hook is passed from 10 to 12 millimeters backward between Tenon's capsule and the sclera. With the hook flat against the latter, the point is then turned upward toward the roof of the orbit so as to engage the reflected tendon and sheath of the superior oblique muscle. The tendon can be identified by its color and by palpation under traction. Depending on the amount of hyperphoria present the tendon may be incised or a variable amount of it may be removed. The conjunctiva is then closed.

The patients were divided into three groups. The first group was made up of those who had had a simple tenotomy lateral of the superior rectus muscle, and in whom good results had been obtained in only 1 case out of 4. The second group was made up of 1 patient who had had a simple tenotomy on the lateral side of the superior rectus muscle in which group there were only 2 failures, the 4 remaining patients having from 13 to 15 prism diopters of correction in the field of greatest action of the superior rectus muscle. In the third group there were 10 patients who had had tenectomy without a simple failure the amount of correction in the field of greatest action varying from 10 to 15 prism diopters.

Trachoma & Possible Carrier Status MARTIN BO-
trch Update Chlc 047 35 450.

The author attempted to determine the morbidity rate of a possible carrier state of trachoma among the natives of Fiji, and to determine the spread of trachoma in America troops stationed in that region.

1. Fifty American soldiers who had lived there under strict military sanitation for over a year were examined and although nearly all showed mild conjunctival hyperemia none was found to have trachoma and no inclusion bodies were found on any slide made.

The 100 rats used were not representative of the population but had been selected as laborers at the Army installation. Twenty-two per cent showed evidence of active trachoma with 15 of these showing brownish filaments after inclusion bodies.

Twenty-seven natives without clinical evidence of trachoma also showed in one or both eyes inclusion bodies which were microscopically indistinguishable from those observed in smears from trachomatous patients. Iclusion bodies of other diseases which could be taken for trachoma do not exist in this locality. Follow-up observations on this trachomatous-free group with inclusion bodies

failed to show any change over a period of 4 months. Since these natives did not develop trachoma after the 5 to 12 day incubation period it was suggested that they were carriers. The author doubted that these patients could have been infected and had a spontaneous cure without clinical evidence of the disease.

ROGER H. JOHNSON M.D.

An Unusual Case of Symmetrical, Bilateral, Non-traumatic Iris Prolapse M. L. NAMRA. *Brit. J. Ophth.* 1947 31 700.

This is a case report of a 22 year old negro woman who had had burning of both eyes followed by a purulent discharge and intense photophobia. On first examination 2 weeks after the onset of symptoms she was found to have a staphyloma in the upper quadrant of each eye. The pupils were irregular and drawn upward.

One month following her original symptoms, examination showed a bilateral iris prolapse between 11 and 1 o'clock. The pupils were drawn upward but were not involved in the prolapse. The eyes were otherwise normal and there were no signs of inflammation.

The prolapsed irides were seared with the electric cautery and a thick conjunctival flap was drawn over each opening. The results were good.

The author surmised that an acute conjunctival infection was complicated by the formation of corneal ulcers, with their subsequent rupture and prolapse of the irides.

ROGER H. JOHNSON M.D.

Postoperative Complications of Cataract Extraction. WILLIAM F. HUGHES JR., and WILLIAM CONZMAY OWENS. *Arch. Ophth. Chic.* 1947 38 577

The authors report the postoperative complications of cataract extraction. They found that the majority of postoperative complications were related to the type of operation performed rather than to the general systemic condition of the patient. The following routine technique of cataract extraction is now used at the Wilmer Institute.

The pupil is dilated with a solution of 2 per cent homatropine the anesthesia and akinesia are obtained by the Van Lint technique or the O'Brien block, by retrobulbar injection of 1.5 to 2 c.c. of 2 per cent procaine hydrochloride and repeated instillations of 0.5 per cent tetracaine hydrochloride (the intravenous administration of sodium pentothal may be used for apprehensive or unco-operative patients) a superior rectus traction suture is inserted, a conjunctival flap about 3 to 4 mm. is dissected down to the limbus from 10 to 1 o'clock, a shelving horizontal groove is made by means of a Lundsgaard knife halfway through the corneoscleral tissue at the base of the conjunctival flap from 11 to 1 o'clock two corneoscleral sutures of No. 000000 braided silk are inserted through these grooves according to the technique of McLean the corneal incision is made with a Graefe knife (or, if desired, with a keratome) the incision may be enlarged with scissors one per-

ipheral iridotomy is made between the two sutures at 12 o'clock the lens capsule is grasped with intra-capsular forceps at 6 o'clock, under the iris and the lens is delivered by tumbling through the round pupil with counterpressure applied below the corneoscleral sutures are tied the iris is repositioned and the conjunctival flap is restored to its normal position with silk sutures. Physostigmine salicylate 0.25 per cent solution is instilled and penicillin ointment introduced. The patient is allowed out of bed within 72 hours after operation. The pupil is dilated with atropine on the first or the second postoperative day. The sutures are removed on the eleventh day and the patient is discharged the next day.

Hughes and Owens studied the causes treatment and prognosis of complications following cataract extraction in a series of 2,086 cases. They conclude that the complications resulting from insecure closure of the corneal wound can be prevented in most cases by the use of two silk corneoscleral sutures. These complications which include gaping with prolapse of the vitreous or iris delayed re-formation and hemorrhage into the anterior chamber can be treated by excision of any vitreous, lens capsule or iris tissue caught in the lips of the wound and closure by means of a conjunctival flap or additional corneoscleral sutures. Should the anterior chamber not re-form within 7 to 10 days air should be injected into it.

Postoperative iridocyclitis occurs when lens cortex is retained in patients who acquire a hypersensitivity to the retained lens cortex. These patients respond to intracutaneous desensitization and surgical removal of the lens material. Iridocyclitis may also result from loss of vitreous at operation or from late rupture of the hyaloid membrane.

Secondary glaucoma may follow postoperative iridocyclitis. Surgical intervention rather than miotics is usually required.

Detachment of the retina is associated with loss of vitreous at the time of operation. The results obtained with perforating diathermy were poor if more than 2 months had elapsed after the onset of the detachment or if the retina was not replaced after withdrawal of subretinal fluid. In the latter event injection of isotonic solution of sodium chloride into the anterior chamber may be tried as a means of forcing the retina back into position.

JOSHUA ZUCKERMAN, M.D.

A Case of Pseudoglaucoma J. A. MAGNUS. *Brit. J. Ophth.* 1947 31 693

The author reports a case of pseudoglaucoma. Many cases have been reported previously in the literature which presented typical glaucomatous cupping but without any increase in the intraocular pressure. The case presented by Magnus was associated with calcification of the internal carotid artery of the patient who was 74 years of age, and had a blood pressure of 160/80. Both fundi revealed deeply cupped slightly pale disks. Provocative testing by keeping the patient in a dark room for an

tend to be wide at the top and taper toward the lobule, being roughly triangular.

Since the earliest conception of the protruding ear was that it stood out directly from the skull, it is natural that the first attempts at correction attempted to pull the entire ear close to the head. When the true nature of the deformity was realized an entirely different approach developed. We may then divide correction methods into two groups, the first of which is of historical interest only. Two groups are presented for classification: group 1 comprises those methods designed to bring the entire ear closer to the head; group 2 comprises those methods designed to produce a normal anthelix and preserve the essentially normal contours of the other parts.

Luckett's introduction of a new approach to the problem of the protruding ear greatly improved results. Any of the various operations based on this fundamental concept produce acceptable ears. It has been the author's experience that no one method is universally applicable to all cases. Generally speaking, the use of mattress sutures, Lembert sutures, gauze bolsters and special materials such as steel wire seems unnecessary if the cartilage of the ear has been adequately weakened and adjusted.

The author describes in detail his method of correction. It is illustrated with 6 figures and there are many accompanying photographs of various deformities.

JOHN F. DELANEY, M.D.

Endopreauricular Surgery in the Treatment of Chronic Otitis Media (La cirugía endopreauricular en el tratamiento de las otitis medias crónicas)

AGUIERO LATORRE AGUIERO *Rev. otorrinol.*, 1947 7 57

Aguiero relates his experience with the endopreauricular operation for chronic otitis media in 38 patients ranging from 11 to 50 years of age. There were 9 males and 28 females. The Leinhardt and Kettel techniques were employed under local anesthesia with a 2 per cent novocaine. The incision and operative procedure are illustrated in the accompanying sketches (Figs. 1, 2, 3 and 4).

Constant irrigation is done with normal saline solution throughout the operation, which keeps the field clean and promotes good vision. The post-operative results are good. Besides the esthetic scar value obtained by this procedure, there is little rise in temperature, no significant pain and the minor character of the effect upon the patient is such that there is no contraindication even in cardiac patients. One of the patients had malignant endocarditis. Of the 38 patients operated upon, only 6 have persistent otorrhea. There was no case of perichondritis, facial paralysis, or meningitis or sinus complication.

The author stresses preoperative x-ray studies and the importance of small cells found around the mastoid antrum in the region of Citelli's angle. These must be removed as they may be the cause of failure in eradicating the purulent otorrhea. The hearing of

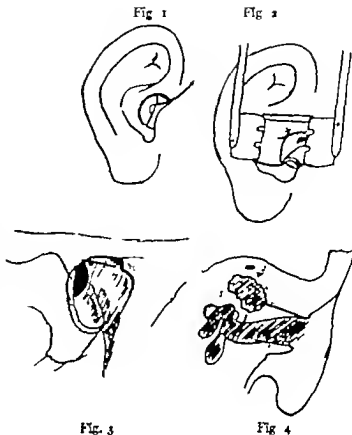


Fig. 3

Fig. 4

the individuals operated upon depends on the injury sustained by the inner ear before the operation. These reasons are advanced to show the advantage of this type of operation over that with the retroauricular approach.

STEPHEN A. ZIEMAN, M.D.

Carcinoma of the Middle Ear and Mastoid Process.

ARNOLD A. GROSSMAN, W. ALLEN DOWNHILL and MAURICE F. SUTTMAN *Ann. Otol. Rhinol.*, 1947 56 709.

Carcinoma involving the middle ear is usually not seen until late, at which time it is difficult to determine its site of origin. By the use of the tympanic membrane as a line of anatomical delineation these neoplasms may be classified as (1) those arising in the middle ear and mastoid, (2) those arising in the auditory canal and aural canal, and (3) those which involve all of these structures, which makes their site of origin undeterminable.

The most common symptoms are otorrhea of long standing and pain out of all proportion to the clinical findings. Bleeding and ulceration are common. Facial paralysis occurred eventually in all of the cases. The labyrinthine capsule is relatively resistant to invasion. Dysphagia and inarticulate speech develop when the jugular bulb region is involved. Direct extension is common along the external auditory canal to and from the tympanum. Regional lymph node metastasis occurs only late. Early diagnosis depends upon early biopsy of recurring suspicious granulation tissue which appears in the auditory canal.

surface of Shrapnell's membrane and (3) that bone sand and bone alivers, which are products of the operation, be completely removed as if left present, they accelerate bone regeneration.

However surgeons performing this operation still find numerous closures of the fenestra. The author has attempted to discourage the formation of connective tissue around the rim of the fenestra so as to avoid its closure. This is accomplished by (1) controlled bleeding in the surgical wound and creating the fenestra in an absolutely bloodless field (2) never sealing the fenestra with the tympanomeatal membrane in the presence of even the smallest amount of bleeding anywhere in the surgical wound, and (3) changing the site of the fenestra. He changed the site of the fenestra by making the fenestration directly into the vestibule instead of into the lumen of the external semicircular canal posterior to the ampulla. In this way a larger opening could be made perhaps giving the fenestra less chance of closing.

This new technique, known as the nov-ovalis technique has made it possible to improve air conduction hearing to the practical level in about 80 per cent of the most carefully chosen cases however the continuous maintenance of adequate hearing for more than 2 years and permanently thereafter has been obtained in only about 75 per cent of cases postoperatively.

Further techniques must be developed to aid in the diagnosis of cases best suited for the operation. The tests needed are (1) a practical and specific objective test for the accurate preoperative determination of the unused reservoir of cochlear nerve function existing in the ear chosen for fenestration (2) a technique embracing a definitely proven specific way for preventing osteogenesis from arising postoperatively in any of the three histologic layers of the freshly injured bony walls of each and every newly created fenestra. It is only when these can be found that the end results of the operation can be reasonably predicted.

The author discusses briefly what he has done to accomplish the development of an objective means of testing hearing, i.e. the determination of bone conduction with the use of tuning forks by watching very carefully the actions of the patient, which will do more towards telling him when the patient is no longer able to bear the tuning fork than any remark on the part of the patient as many patients will state that they hear the tone long after they have stopped hearing it.

What has been done towards the development of specific means to prevent osteogenic closure of the newly created fenestra is discussed. Observations made in human ears during revisions of osteogenetically closed fenestrae and histologic studies in the rhesus monkey revealed that osteogenesis takes place in the endosteal periotic and enchondral layers of the fenestral rim. In view of these observations it became quite obvious that if a newly created fenestra was to remain open permanently means and ways of

hindering osteogenic repair locally within all the three histologic layers of the bony rim would have to be devised. The histologic structure must be devitalized and inactivated without being destroyed.

In his attempt to force healing of the freshly cut bony walls of the fenestra without osteogenic repair by instituting physical resistance to prevent the onset and spread of osteogenesis the author employed the following means:

1 Soft tissue resistance by pressing the tympanomeatal membrane tightly into the fenestral gap when sealing the newly created fenestra. (This however proved to be of little value.)

2 Physical resistance with an inert metal obturator frame (The author still believes this is an excellent way to prevent osteogenesis but it can not be satisfactorily used until a method can be developed of creating a fenestra of standard size and shape in the bony labyrinth so that a prefabricated inert metal frame of the same size can be inserted with ease.)

3 Physical resistance with a cartilage stopple (He employed this in 750 cases with much evidence that the technique when quickly applied prevents inflammation of the labyrinth and osteogenesis. However many of the patients lost their hearing and it was shown that the decrease in hearing is caused by a fibrous adhesion between the edges of the fenestra and the cartilage or by osteogenesis covering the cartilage stopple if it did not extend deep enough into the fenestra or was not sufficiently elevated from the outside surface. Also in some cases the stopple was too firmly applied into the fenestra and hearing was not satisfactory from the first. The author has therefore abandoned this technique.)

Attempts were made to prevent osteogenesis according to the second principle—by devitalizing and inactivating the histologic structure responsible for it. The author in a number of cases polished the edges of the fenestra with a dental polishing burr of different metals mainly steel gold pure lead and silver amalgam.

Experimental work carried out by the author and several of his associates at the Harvard Medical School, Boston on rhesus monkeys is briefly discussed. A different technique was employed on the animals and one ear on each was used as a control. On a number of animals the edges of the fenestra were burmished with the burrs of different types in which the burrs from pure lead were used and in these 3 ears there was no closure of a newly formed fenestra. Further control studies are being repeated on monkeys with the use of pure lead burrs, and the results are awaited.

On the basis of the histologic evidence obtained in burmishing the edges of all of the fenestra that he makes with the pure lead burr and hopes now that he has reached some successful technique that will make the fenestra remain permanently patent and therefore result in successful improvement in the hearing of all carefully selected cases. The steps

of the fenestra in the left ear. The fenestra non-ovalis is described.

In a third present, numerous quotations from the full text of papers are included, numerous histologic slides showing the histologic changes occurring with the closure by osteogenesis of the fenestra.

WILLIAM A. ANGELO, M.D.

Osteogenic following Fenestration of the Vestibular Labyrinth of the Rhesus Monkeys: A Controlled Experimental Study. JAMES LAWRENCE, JR., M.D., and LEONARD A. SCHALL, M.D., Boston, W. J. Lippincott Co., 1941, 46 p., \$2.50.

Through the courtesy of LeRoy A. Schall in the Department of Histology at the Harvard University Medical School, Boston, Lempert outlined the method of research in osteogenesis of the postoperative event of osteogenic closure of a fenestra non-ovalis in the vestibular labyrinth of the rhesus monkey.

All operations were performed by Meltzer in the experimental department which was performed by Lempert and Meltzer. The tissues were prepared in the Massachusetts General Hospital, and in the Lempert Laboratory and in the direction of Dorothy Wolff.

The investigation included three separate phases. Phase 1 was a study of the three individual histologic layers of the freshly cut bony rim of the fenestra of the rhesus monkey to determine the part played in osteogenic closure of the fenestra in phase 2 attempts were made to prevent osteogenesis in all three histologic layers by the use of various materials locally the histologic structure was studied in phase 3 attempts were made to prevent the closure of the fenestra.

In performing the experimental fenestration in the middle ear, the control of the peripheral endolymphatic space was studied.

The experiment was limited to a study of how osteogenesis replaced the freshly cut bony wall of the fenestra and the effect of the peripheral endolymphatic space.

The perimeter of the fenestral gap was not closed with cement, as it removed any doubt of the validity of the results. The results of the experiment are considered in the explanation and interpretation of the results of histologic observations.

In experiment 2 and 3 in which special experimental factors were introduced in an attempt to prevent osteogenesis in the right ear of the monkey, the left ear was operated on with the same technique as the right ear. In the right ear, the left ear was the experimental (control) ear used. In the right ear of each monkey was a control experimental ear, while the left ear was a control ear in monkey 3. In experiment

3) in which the reverse was the case. In all cases both ears were operated on at the same time.

With such controlled experimentation it is possible in the evaluation of the end result to eliminate error resulting from the fact that the control ear is influenced by biological factors influencing osteogenesis in the experimental monkey was unknown.

Experiment 1. In this first series of 13 monkeys (26 ears) the endosteum was left intact in the right ear and removed in the left ear. This was to determine whether the leaving or the removing of the endosteum made any difference in the end result. The results were given as day to day results and by the tenth day regeneration was complete with complete closure of the fenestra. Although early stages of fibrosis and regeneration were more rapid in the right ear on the side on which the endosteum had been left intact later stages showed complete regeneration on both sides with no distinguishing difference.

Experiment 2. Sixteen monkeys (32 ears) were used. In this experiment attempts were made to accelerate the histologic elements responsible for osteogenesis by burning the freshly cut rim of the fenestra in the right ear with various metal tips, a medicament and with an electrocoagulating current. The results showed that burning with 22 carat gold did not prevent bone regeneration, nor did burning with silver. Burning with silver amalgam retarded but did not prevent bone regeneration. Burning with a per cent aqueous silver nitrate solution retarded but did not prevent regeneration of bone nor did burning with stainless steel. Burning with electrocoagulating current had about the same results. Burning with pure lead prevented bone regeneration in the fenestra after 6 months and 25 days in the only 2 monkeys in whose cases the experimental fenestra was burned with pure lead. The control fenestra of these 2 monkeys were completely repaired by new bone.

Experiment 3. In the right ear of monkey A, the entire external semicircular canal was fenestrated. In the left ear a small fenestra was made in the external semicircular canal. The results showed regeneration to be complete in both ears. It was revealed that the length of fenestra seems to have bearing on ultimate regeneration of bone.

Experiment 4. Six monkeys (12 ears) were used. A cartilage stopple was placed in the fenestra of the experimental ear and over this a flap was placed in the opposite or control ear. The flap was placed over the fenestra but no stopple was used. Examination of the experimental ears showed that after 3 months the stopple was firmly anchored by new bone. The flap was not below the level of the stopple and no new bone was also invading the cartilage. Regeneration did not occur where the stopple fitted firmly to the edge of the fenestra. Thus the experiment showed that regeneration did not occur where the cartilage stopple fitted firmly against the cut edge of the capsule.

Experiment 5. Five monkeys (10 ears) were used. A film was inserted into the fenestra of the

penmental ear while in the control ear either a different kind of fibrin film or the skin flap alone was used. The results showed that fibrin film does prevent regeneration.

In summary the authors note that their results show only one hopeful conclusion viz that the burnishing of the edge of the fenestra with pure lead may be the means of keeping the fenestra from closing through osteogenesis.

The article includes histologic photomicrographs of specimens and tables showing the results in each experiment.

WILLIAM A. ASHROON, M.D.

Revision of the Fenestration Operation PHILIP E. MELTZER Arch Otol. Chic. 1947 46 528

The author mentions the fact that this subject has been little discussed in recent literature and that now otologists are having the opportunity of reviewing statistical reports of the end results from the fenestration operations. It now becomes apparent that there is a definite need for such a discussion. It is generally agreed among experienced surgeons that when cases are well selected a large majority of the patients will have the hearing improved to the practical level in consequence of the fenestration operation. This improvement occurs usually within 3 to 6 weeks. The percentage of cases in which hearing is so improved varies from 70 to as high as 90 per cent. However, in spite of the actual percentage of early good results ultimate failures are of such frequency that the question of revision is of major importance.

Accidents excluded the causes of postoperative failure in order of their importance are osteogenesis fibrosis, and labyrinthitis. The effect of the labyrinthitis varies with the severity of the condition mild cases result in very little damage to the hearing while severe cases have total loss of hearing.

Fibrosis as a cause of failure is hard to evaluate as, no matter how careful an operator may be, a film of blood elements will accumulate under the flap with resulting fibrotic tissue hindering down the flap to the bony capsule thus causing a decrease in hearing. The fibrous tissue may be minimal or quite extensive, even growing into the window and partly into the space containing the perilymph.

The most important cause of closure is osteogenesis in which new bone may completely or partially replace any connective tissue matrix. This may occur rapidly or slowly or may pile up in a large growth at the site of the fenestra. It may completely or only partially close the fenestra and in some cases the new bone is easily distinguishable in the first year or two but later on it becomes indistinguishable from the surrounding bone.

It is possible for any combination of these causes to take place to a greater or lesser degree.

As a failure may occur after the operation, it causes anxious waiting on the part of the patient and surgeon following the operation. Many patients will be disappointed and the results are variable dependent on constitutional factors beyond one a con-

trol. Some surgeons doing this operation have not obtained a high percentage of success and to them revision is important, and they would like to know when and under what circumstances reoperation is a reasonable undertaking.

Suitability for the selection of patients for revision would be determined after a complete study has been made of the record of the patient, including preoperative audiograms review of what occurred at the original operation and of the events that occurred postoperatively.

Assuming that the operation was carried out perfectly the fenestra was well made and of adequate size with no endosteal shreds and bone chips remaining the author offers the following opinion as to when revision should or should not be done.

When not to revise (1) a revision should not be done when a patient fails to get any improvement of hearing following the operation (2) it should not be done in a patient whose hearing recedes after he has obtained a limited improvement only and has never reached a practical level at any time postoperatively (3) revision should not be done in a patient whose threshold is improved in the lower frequencies but not to the practical level in the important speech frequencies (4) it is unwise to reoperate on a patient who had a good improvement and then rapidly lost it within a matter of 3 to 6 weeks especially if the hearing has receded below the preoperative level. This usually means fibrosis.

When to revise (1) a revision may be undertaken in any case in which a fenestra was made that was possibly too small. In this type of case the patient may lose his improvement rather rapidly within 6 to 8 weeks (2) if the hearing improvement remains for 6 to 8 weeks and is then rapidly lost and one has a feeling that a fragment of bone might have made its way into the window or that possibly a spicule of bone was attached to the canal wall membrane one is justified in revising sooner than usual provided the cavity is clean and well epidermized.

When one is contemplating a revision in some cases vestibular tests may afford valuable information as the fistula response is excellent in a fenestra that has remained patent but is negative if the fistula has closed.

It is much better to wait for all inflammatory reaction to subside. The best time for revision is usually from 6 to 8 months after it has become evident clinically that the fenestra has closed.

If the cartilage stopple technique was employed the following observations may help to guide one as to the proper time for revision (1) when a cartilage stopple is well fitted and firmly inserted into the fenestra the result may be that there is no improvement of hearing (The reason is that under this condition the stopple is immobile, being too tight and sound cannot be transmitted through the fenestra. In such cases, in which the hearing remains practically the same a revision may be undertaken within 4 to 6 months or earlier depending on the appearance of the cavity) (2) when a stopple is well fitted

but yet not too firmly and the learning is good for the ear and then it will recede to the pre-operative level and revision may be undertaken 4 to 6 months later. Revision may be undertaken in cases with partial improvement never reaching the pre-operative level of hearing at 6 months later.

In some cases that presumably were well selected for revision the findings at operation may be so different from those expected that prudence justifies the immediate replacement of the flap. If during revision it seems difficult to expose the perilymphatic space and therefore that further instrumentation will result in damage of the labyrinth the operation should be stopped. On elevation of the bone membrane and the tissue extending into the middle ear the perilymphatic space may be filled with a small amount of fat. Attempted removal of this material will usually cause evulsion of the membrane labyrinth with irreplaceable damage and if this material should be discovered the ear should be left alone.

Of the relevant factors from the history of the case to be taken into consideration in considering revision.

A case is not a good subject for revision if it is malignant, soundness determined from the history.

If the bone wall of the middle ear at operation was found to be usually broken with great probability of revision. This will be true when the fenestra is revised.

If the bone wall was fractured at operation, particularly that part nearest the middle ear membrane it may be that a fragment has remained attached. This will have resulted in a foreign body. In such cases revision is indicated.

If labyrinthitis occurred, the patient after the operation has usually been contraindicated. The leveling of the improvement of hearing when it was noted and when the hearing began to decline will probably lead to the diagnosis of early labyrinthitis and the need for reoperation.

A case in which rapid loss of hearing has occurred since the first operation frequently allows modification of the patient's usual unsatisfactory operation.

Patients who have been postoperatively satisfied but reach a pre-operative level at a later time are satisfactory for reoperation with the exception of those patients who have had a long history of inserted.

WILLIAM A. A. M. M.D.

Medical and Surgical Care of the Patient Selected for Fenestration of the Labyrinth. J. M. D. A. J. Otolaryngology 1937 4: 551

The author states that the hearing for normal speech can be restored in a large percentage of patients with the ear selected for fenestration. If the patient has a middle ear disease, it is essential that it be removed. If failures occur, the patients become better. The failures have been more numerous in the past but have been more numerous in the past.

of dizziness. The author believes that the ear and failures and the number of disappointed patients may be markedly decreased if the success of the fenestration operation are thoroughly trained and able to carry out the operation with perfect technique. However many men who have not as yet had the necessary experience are performing the operation and their patients make up a large number of failures.

There are three primary causes of failure: (1) diagnosis and selection of cases, (2) fibrous reaction in the vestibule from hemorrhage, the entrance of foreign material or damage of the vestibular nerve, and (3) closure of the fenestra.

It is the author's opinion that closure of the fenestra is due not merely to the natural tendency of bone to regenerate but to bone dust, endosteal tags or spicules of bone left in the fenestra or on the flap covering it or to an inflammatory reaction. The author provides the stimulus necessary for bone regeneration. He believes therefore that the fault comes with the operator as a clean fenestra covered by a clean and healthy flap will not close in the absence of a stimulative inflammatory reaction.

Every surgeon who undertakes this work should keep a careful record of every case not only the history of the patient but a record of the operation, procedures and of the postoperative course. If it does this and failure occurs, he can look back and find the cause and similar failures in other patients may be obviated.

Aside from the technical procedure of the operation itself, there are other details associated with the medical and surgical care which are important. The person who is to undergo the operation should be in good condition both physically and mentally. Preoperatively special attention should be paid to the possibility of active nasal allergy as the author believes that failure resulted in at least 2 of his cases because of active nasal allergy causing inflammation of the ear which in turn stimulated bone regeneration. Physiologic instability also must be reckoned with as a psychic shock from having one's fear of the operation may be just as severe as the shock of failure. The author has seen a patient in whom active manifestations of dementia praecox developed after a successful fenestration.

The author states that practically all of the operations can be done under a local anesthetic and that the patient must be given a careful explanation of what he may feel and hear during the operation that he will not become unduly upset.

The author's ideas concerning preoperative preparation and the surgical preparation for the operation are presented. He believes that a septic solution should be kept out of the ear canal because they may promote inflammation but it is simply filling the ear canal with a 5 percent alcohol for 30 minutes is effective and does not cause discomfort. The packing used in the cavity at the conclusion of the operation should be nonirritating and should be a good structure and paraffin gauze is satisfactory.

It should not be packed too tightly as it may cause pain, and pain indicates the presence of some inflammatory reaction. Patients sit up on the day of operation if possible and get out of bed on the day following. The author has noticed if this is done the labyrinth becomes more quickly adjusted.

Postoperative care of the cavity is very important and some failures can be traced to poor care and discontinuation of treatment before the cavity has become completely healed. The author mentions many minor surgical principles but he believes that all surgical procedures whether minor or major should be carried out with extreme care in order that satisfactory results may be obtained in all cases.

WILLIAM A. ANDROO, M.D.

Training of the Surgeon and Selection of the Patient for the Fenestration Operation J H MAXWELL, *Arch Otolaryngol* 1947 46 539.

Apparently the technical training of most surgeons performing the Lempert operation has been fairly adequate from the standpoint of anatomic dissection. It should not be forgotten however that the operation is something more than an anatomic dissection to be performed on the living patient. It is a major surgical operation involving vital structures and requiring for its satisfactory performance a high degree of technical skill. The prerequisite training of the surgeon who is interested in the treatment of otosclerosis should include, first of all, a wide background of diagnostic and surgical experience in the general field of otology. After he has studied the entire problem of deafness in all its phases this well disciplined otologist is ready to prepare himself to perform the fenestration operation. In the final preparation it is generally advisable for him to go to an institution such as Lempert's laboratory where he can perform the operation on cadavers under supervision and also have many opportunities to observe experienced surgeons perform the operation. It is most important for the beginner to study the skills by which experienced surgeons surmount the various technical difficulties of the procedure.

It is readily admitted that there is considerable latitude in the selection of patients suitable for the fenestration operation. Any attempt to draft hard and fast rules fixing the degree of handicap the exact positions of the air conduction and bone conduction curves on the audiograms or the age limits in regard to this operation is entirely beyond the author's province and capability. Certain principles, however must be held inviolable and after careful attention has been given them, the final decision must be based on clinical experience moderated by common sense.

In the first place it is obviously necessary to make a reasonably accurate diagnosis of the hearing impairment of which the patient complains. The conductive deafness which may lead to a diagnosis of clinical otosclerosis must not be determined from the audiogram alone or from the audiogram in addition to a casual and superficial objective examina-

tion. Nasopharyngeal examination and otoscopy to exclude tubotympanitis or adhesive otitis as the cause of impairment of hearing are time consuming but are important parts of the examination.

It is highly desirable to have a series of three or four audiograms taken several days apart in an effort to gain accurate information regarding the acuity of the patient's hearing of pure tones. The hearing should then be tested routinely with tuning forks since they give valuable information in the vast majority of cases. The candidate for fenestration should have a strongly negative Rinne test and a positive Schwabach test with the C 3 (1024 double vibrations per second) tuning fork, and with few exceptions he should lateralize sound in the Weber test to the worse ear when the C 3 and C 4 forks are used. The chief value of the tuning fork test is to check the audiogram which on many occasions is found to be inaccurate in spite of frequent calibration of the audiometer.

In addition to the tuning fork tests and pure tone audiometry, the testing of speech reception is most important, for it is obvious that the patient's greatest interest is in his ability to hear speech. It is to be hoped that the time will soon come when all reported results of the fenestration operation will show the preoperative and postoperative thresholds of speech reception. The degree of the patient's handicap and the success of the operation can be shown to much better advantage by this means.

The author believes that no patient is suitable for the fenestration operation unless it can be shown by accepted tests that there is sufficient cochlear function to permit the hearing to be restored to a serviceable and practicable level through the successful by-passing of the obstructive element.

Handicapped persons will grasp at straws. The patient with profound deafness is willing to try almost anything that offers even a faint ray of hope that his affliction will be ameliorated. Many times such a patient will beg the surgeon to do the fenestration operation even though he has been told that he is unsuitable. The performance of the fenestration operation as a surgical experiment is a violation of the ethical concepts of the profession. As a surgeon, one does not have surgical commodities to sell. One has opinions and advice to offer. If a surgeon feels that the operation should be done he should so advise the patient. If according to available and accepted hearing tests a patient is classified as unsuitable for the fenestration operation, the operation should not be recommended. This patient should be apprised of his condition and given advice and assistance in regard to rehabilitation through speech reading and the use of a hearing aid.

JOHN F. DELP, M.D.

General Correlation MARVIN F. JONES, *Arch Otolaryngol*, 1947 46 544.

There is a definite and too great element of error in the present methods of arriving at a diagnosis of otosclerosis, which precludes dogmatism.

and other parts of the brain. Although much anatomical and histological investigation has been carried out, the exact pathways in many instances are not known. It is this lack of detailed knowledge which renders the information derived from the vestibular tests of questionable value in diagnosis.

Dizziness or vertigo may result from stimulation or disease of any of the structures concerned in the maintenance of balance. We therefore may have ocular vertigo, central vertigo or labyrinthine vertigo. Frequently it is difficult to distinguish between the various causes. We must rely upon the history and the description of the vertigo and upon the associated signs and symptoms.

If the cause of the dizziness or vertigo is within the labyrinth, there is frequently associated evidence of disease of the cochlear mechanism as instanced by the presence of deafness and tinnitus. The vestibular tests may or may not be abnormal. There may be spontaneous or positional nystagmus.

Vestibular tests for the semicircular canals include the rotation, the caloric, and the galvanic tests but by far the most commonly used test is the caloric test. It has the advantage over the rotation test of stimulating only one labyrinth at a time. It has an advantage over the galvanic test in that it stimulates only the end organ and not the vestibular nerve.

The cold caloric test is used much more frequently than is the hot probably because it is difficult to arrange hot stimulation so that it will be effective and yet not be painful to the patient.

For a cold water test, 2 or 3 c.c. of ice water introduced by a syringe under vision and kept in contact with the ear drum for 20 seconds is a very practical ward or office test. The nystagmus if timed from the onset of stimulation lasts for 2 or 2½ minutes.

A simple and dependable method of carrying out the vestibular caloric test is to use a Dundas-Grant coiled tube for cold air. The air is cooled by pouring ethyl chloride on the covering cloth mesh. The advantage of this method is that it is simple to carry out and can be done in any hospital ward or doctor's office. The cold air makes the test safe even when there is a perforation in the drum.

A clinical vestibular test must be as all informative as possible and yet it should be as simple as possible. Any increased complexity in the test must give dependable information which is of clinical value before it is accepted. If we allow the test to become too complicated or if we attempt to conclude too much from a test, it will fall into disuse and disrepute.

JOHN F. DELPH, M.D.

Pathology of Vertigo Arising from the Peripheral Vestibular Apparatus. J. R. LINDSAY. *Ann. Otol. Rhinol.* 1947, 56, 541.

Vertigo is a common symptom of a disturbance of either the peripheral labyrinth or its central nervous pathways.

In disease of the central nervous system such as encephalitis, abscess, tumor and multiple sclerosis, the symptoms result from direct involvement of

vestibular nuclei or pathways or from pressure. Vertigo following head injury with concussion probably is central in origin if unaccompanied by auditory disturbance.

Vertigo without deafness or tinnitus occurs frequently as a toxic manifestation in the course of some respiratory and gastrointestinal infections. It may occur in cerebral arteriosclerosis and hypertension and also in hypotension and during the menopause. The localization is indefinite but the absence of auditory symptoms suggests that it is central and the pathologic disturbance of a mild and reversible character.

Vertigo can be localized to the peripheral labyrinth or eighth nerve when the symptom is associated with deafness and tinnitus. The most frequent cause in the past has been a labyrinthitis, due to extension of inflammatory disease in the temporal bone, or to meningitis. The pathologic process in the inner ear in various types of labyrinthitis, tumor and fractures of the temporal bone have been described in standard texts.

A disturbance of the peripheral labyrinth may also occur from several other causes. A nonsuppurative otitis media may produce vertigo which in some cases is relieved promptly by inflation or removal of serous fluid. An attack of extrinsic allergy may in rare cases cause vertigo. The nature of the inner ear disturbance in these is indefinite. Certain infections, particularly virus diseases, may affect the inner ear and produce rapid, profound loss of hearing and in occasional cases, vertigo and some loss of vestibular function. Precise information as to the pathologic process in the inner ear is lacking since material for pathologic study is rarely available.

A sudden onset in previously healthy ears of tinnitus, deafness and vertigo which leave a profound and permanent impairment of function if occurring in middle life or later is considered to be due to a vascular accident in the labyrinth. A similar episode sometimes occurs before middle age and in these cases it may be impossible to differentiate the condition from an acute toxic process. A toxic disturbance affects auditory function primarily however and may not impair vestibular function. Precise pathologic information in this type of labyrinthine lesion is not available. A fibrous labyrinthitis occurring in the late stages of leukemia has been described and is thought to be the result of hemorrhage in the labyrinth.

The clinical condition now called Meniere's disease, which is characterized by recurring attacks of vertigo with fluctuating tinnitus and deafness is now known to be associated with a hydrops of the labyrinth. This type of hydrops is distinguishable from that which sometimes occurs in inflammatory inner ear disease since in the former there are no inflammatory changes in the perilymphatic spaces and degeneration of the peripheral cochlear neuron is usually absent. The term idiopathic labyrinthine hydrops is customarily applied. The etiology is not known.

JOHN R. LINDSAY, M.D.

PHARYNX

Congenital Abnormalities of the Pillars of the Fauces and the Action of the Posterior Pillars and Nasopharyngeal Valve during Speech
MICHAEL C. OLDFIELD and L. P. J. MACNAUGHTAN
J. Laryngol. 1946 6 594

Observations were made on patients with several types of congenital defects of the pharyngeal muscles.

On the basis of these observations the author presents the thesis that the palatopharyngeus muscle and the thyropharyngeus muscle previously thought to be parts of the same muscle are independent, both on the basis of development and function. The palatopharyngeus muscle, arising from the posterior pharyngeal wall and entering the soft palate, encircles the pharynx like a horseshoe-shaped sphincter and gives rise to the horizontal ridge on the posterior pharyngeal wall known as Passavant's ridge. The thyropharyngeus muscle, arising below from the posterior margin of the thyroid cartilage and pharyngeal sphenoid and passing upward on the lateral wall of the pharynx passes medially to the palate and forms the posterior pillars. The action is to bring the lateral pharyngeal walls and pillars medially. The posterior pillars play a subsidiary but important role in closing off the nasopharynx. One patient with congenital absence of the left posterior pillar was observed to have a nasal quality to his voice because of inadequate closure. The uvula serves no function in the closing of the nasopharyngeal isthmus.

JOHN R. LODGE, M.D.

NECK

Clinical Significance of Malignant Neoplasms of the Thyroid Gland WALTER F. ROCKES, JR., SAMUEL P. ASHBY, JR., and ROBERT H. WILLIAMS.
England J. M. 1947 37 569.

Of 544 918 patients admitted to the Boston City Hospital, the Johns Hopkins Hospital, and the Massachusetts General Hospital, there were 322 with goiters and 64 with a histologic diagnosis of malignant neoplasm of the thyroid gland. Other investigators report a much higher incidence: one has found 17.1 per cent malignancy in toxic nodular goiters and 7.3 per cent in all goiters. In a series of routine autopsies in a region of endemic goiter 1 per cent of thyroid carcinoma was found, whereas in a nonendemic area, only 0.1 per cent of the autopsies revealed cancer of the thyroid.

Of the 64 patients with cancer of the thyroid in the present study 76 per cent were women, 3 males and 22 females were under the age of 50. The age incidence increased regularly up to the seventh decade in 28 per cent of the cases the condition occurred in the seventh decade, in 21 per cent, the sixth decade, and in 18 per cent, the fifth decade.

The principal symptom was enlargement of the neck (86 per cent); next in frequency were hoarseness (18.7 per cent), dyspnea (18.7 per cent), dysphagia (14 per cent), bone pain from metastases (12.3

per cent), nervousness (10.9 per cent) and cough (9.4 per cent). No patient had hypothyroidism; 5 of the 64 patients had hyperthyroidism, and these 5 represented 0.38 per cent of all the cases admitted for hyperthyroidism. Physical signs were a palpable mass in the neck (98 per cent), the masses were nodular in contour (73.4 per cent) and in only 7.8 per cent were there multiple nodules. Enlargement of the cervical glands was found in 23.4 per cent, and of the supraclavicular glands in 7.8 per cent of the patients.

The degree of malignancy was classified as high in 36 per cent, moderate in 50 per cent, and low in 14 per cent of the patients. Of those in whom the condition was classified as highly malignant 70 per cent were dead in 1 to 5 years after operation and less than a third of the survivors were free of recurrence of those with moderately malignant growths, 25 per cent were dead, 7 per cent were living with recurrences 45 per cent were without recurrence and the remainder could not be traced. There were no known deaths in the low malignancy group but about one third of the patients had recurrence.

In order to arrive at a judgment concerning the indications for prophylactic removal of thyroid nodules an analysis was made of the complications resulting from operations on 431 patients with nontoxic goiter. Fifteen per cent of the patients suffered from one or more operative complications and the mortality was 1.16 per cent. 13 patients had vocal cord paralysis.

Since malignancy is most frequently associated with single nodules or masses, prophylactic surgery must be considered, especially in young people in nonendemic areas since in these areas nonmalignant nodules are rarely found in patients under the age of 30. Multinodular glands are rarely the site of cancer. Certain signs in glands with one or more nodules, such as increase in size and in firmness especially with fixation to surrounding tissues, were considered as indications for removal.

The authors do not approve of removal of nodular or diffuse goiter to prevent later development of thyrotoxicosis.

CLINTON H. THURMAN, M.D.

Carcinoma of the Thyroid J. M. GRAMAM and R. McWHIRTER. *Proc. R. Soc. M. Lond.*, 1947 40 669.

One hundred and forty-four unselected cases of carcinoma of the thyroid are reported from an area in which simple goiter is not endemic but occurs only sporadically. The sex incidence was 1 male to 3.6 females. (The simple goiter ratio is 1 male to 9 females.) The average age was 50.75 years with a range from 18 to 83 years.

The diagnosis of malignant disease was confirmed by histological examination in 97 of the cases. In the remaining 47 cases it was made on clinical grounds alone. All sections were reclassified by one pathologist as follows: adenocarcinoma, 23 per cent; papillary adenocarcinoma, 16 per cent; and undifferentiated carcinoma, 61 per cent.

In 34 cases (23%) there was a history of previous "goiter." Three of the tumors had their origin in aberrant thyroid tissue, 2 in a lateral aberrant thyroid and 1 in a lingual thyroid.

Differential diagnosis is a problem in the early stage. The appearance of a nodular goiter in a patient approaching middle age, recent increase in size, or alteration in consistency or outline should be regarded with suspicion. Fixation of the swelling to the trachea while the thyroid still moves freely on swallowing is one of the earliest signs to appear. Forward displacement of the trachea with antero-posterior narrowing of the lumen is much more suggestive of cancer than of simple goiter. The presence of extensive calcification does not exclude cancer. An analysis of the factors affecting the survival rate is difficult in this series for three reasons:

1. The survey is not limited to early operable cases but includes all cases referred to a large general hospital.

2. The series contains a high proportion of undifferentiated carcinomas (61%). These grow rapidly and are often inoperable. 35 per cent of the patients died within a month and 50 per cent were dead within 4 months of the time they first came to the hospital.

3. One third of the cases were not histologically proved to be carcinoma.

Twenty-nine patients were operable. Seven were treated by complete thyroidectomy and the remainder by subtotal thyroidectomy. In 18 cases postoperative x-ray therapy was also given. The 5 year survival rate was 73 per cent.

Among the 108 inoperable patients the 5 year survival rate was 16 per cent. Eighty-four of these

patients had no distant metastases and of these 30 were given x-ray treatment which could be considered adequate. Of the last, 29 per cent were alive at the end of 5 years.

The results obtained as compared with the histologic type of the tumor are as follows: 18 patients with adenocarcinoma—46 per cent alive at the end of 5 years; 13 patients with papillary adenocarcinoma—40 per cent alive at the end of 5 years; and 48 patients with undifferentiated carcinoma—14 per cent alive at the end of 5 years.

As no patient treated by surgery alone survived for 5 years the results must be attributed to x-ray treatment.

An analysis of the radiosensitivity of the 3 histologic subdivisions is given as follows: adenocarcinoma—0 per cent radiosensitive; papillary adenocarcinoma—0 per cent radiosensitive; undifferentiated carcinoma—55 per cent radiosensitive; unknown type—50 per cent radiosensitive.

The criterion of radiosensitivity was a rapid diminution in size of the tumor. Survival rates were ignored for obvious reasons.

Another finding of some help in distinguishing the radiosensitive group was the average duration of the symptoms which was 6.3 months in the radiosensitive cases and 16 months in the radioresistant cases. It is believed that if a tumor is of the radiosensitive type, no attempt at surgical removal should be made because incomplete removal will almost certainly bring about dissemination of the cells (mostly to the lungs).

Operation is indicated only when there is a reasonable prospect of removing the tumor completely.

FRANK R. CUTTEN, M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS CRANIAL NERVES

Encephalography with Small Amounts of Air
KRISTIAN KRISTIANSEN and ARVALD VOGT. *Ida radiol. Stockh.* 947 8 335.

The authors report on encephalographic studies of 100 consecutive patients treated on the neurological service of the Rikshospitalet Oslo. A very small amount of air not exceeding 15 c.c. was used. The usual technique of the authors consisted of removing 4 c.c. of cerebrospinal fluid at 3 different times and injecting 3 c.c. of air at 3 different times so as to use only 9 c.c. of air for the entire study. In 11 per cent of the patients, the ventricles were sufficiently filled for diagnostic purposes, but the degree of filling was incomplete in 73 per cent, and there was no filling in 16 per cent. These studies frequently had to be repeated 2, 3, 4 and 5 times, with a little more air each time, the maximum being 16 c.c. In 30 patients with gross intracranial lesions, good filling of the ventricles with such procedures was obtained in none. In 14 patients with clinical signs of increased intracranial pressure, good fillings were not obtained but 3 deaths were reported among them.

The advantage of causing less headache with such small amounts of air seems to be offset by the fact that the procedure often had to be repeated. The authors have not been satisfied with the procedure and are resorting now to a more adequate injection of air. However they continue to use from 15 to 20 c.c. in the first attempt and if the results are not satisfactory they use from 40 to 60 c.c. of air. They recommend that all encephalographies be performed with the help of fluoroscopy so as to control the amount of air that is required to give a satisfactory filling of the ventricular system.

GEORGE PERRET, M.D.

Carcinoma of the Pituitary Gland with Metastases to the Liver in a Case of Cushing's Syndrome
W. ELIAS FORST. *J. Path. Bact. Lond.* 947 59 37.

A 43 year old woman developed symptoms of the disease known as Cushing's syndrome was treated unsuccessfully by deep x ray therapy and later at operation was found to show no gross tumorous changes in the pituitary gland. Her symptoms progressed and she died 14 months after her first admission to the hospital. At autopsy she was found to have a tumor within the confines of the pituitary gland, which structure had been essentially completely destroyed by the tumor. The tumor is described as being chromophobe carcinoma. In many scattered foci throughout the liver there were small tumors of the same histologic nature as that found in the hypophysis, and in no other organ after extensive study was there found to be any such

metastases. The cells in both the liver and pituitary tumors were quite unlike those of carcinoma of the liver and the gross distribution of the hepatic lesions was not that of hepatic carcinoma. The clinical picture had been, from the beginning, one of primary pituitary dysfunction and not one of liver disease. For these reasons the author believes the case to be one of true metastasis of a carcinoma from its primary site in the pituitary gland to another organ. Such a pathologic situation is a rarity.

JOHN MAXIE, M.D.

Multiple Meningiomas (Meningiomas multiples)
RAMON CARRILLO, RAUL F. MATTEA and TORIBIO INCHAUSTI. *Rev. As. med. argent.* 947 6 56.

The authors report the results of their experience, and establish the accuracy of Cushing and Eberhardt's observation of the existence of 2 anatomico-clinical entities: (1) a clear case of multiple meningioma without any manifestation of von Recklinghausen's disease and (2) this disease complicated by multiple intracranial tumors. Embryologic experiments support this belief.

Multiple meningioma is rare, occurring in from 1 to 4 per cent of tumors of this type. Diagnosis difficult because of the many neurologic symptoms caused by more than one tumor: the ineffectual ventriculography, and the nonmalignant character of the tumors from the histological standpoint.

STEPHEN A. ZIEGLER, M.D.

Neurinomas of the Cerebellopontine Region. A Clinical Study of 160 Cases Including Operative Mortality and End Results. A Correction.
TORIBIO GONZALEZ REVILLA. *Bull. Johns H. Hosp.* 947 80: 54.

The second sentence in the fourth paragraph, left hand column, on page 133 of the February 1948 issue is not correct. The author's own words are as follows:

From all these observations originated Dandy's classical unilateral procedure introduced in 1934 and which is briefly summarized as follows: 1. small unilateral incision as used for Ménière's disease and 2. bone rongeur used as far laterally as possible without entry to the mastoid cells and anteriorly to the lateral sinus. 3. tapping of the posterior horn of a lateral ventricle through a previously placed occipital trephine in the opposite side. 4. evacuation of fluid from the cisterna magna and spinal canal. 5. excision of the outer cap of the cerebellum. 6. intracapsular evacuation of the solid contents and 7. careful painstaking dissection and removal of the capsule. This procedure has been almost universally adopted and the general trend of most neurosurgical clinics at present is to remove these tumors in toto according to the method evolved by Dandy after 20 many years of toil.

SPINAL CORD AND ITS COVERINGS

PERIPHERAL NERVES

Studies upon Spinal Cord Injuries. The Development of Automatic Micturition. JOHN MARTIN and LOYAL DAVIS. *Ann. Surg.*, 1947 126 472

In a study of the rehabilitative problems of the patient with a severe injury to the spinal cord the authors cite their experience with 471 such patients, seen and treated both in civilian and military practice. Injuries at all levels of the cord and cauda equina, both of the open and closed types, made up this large series of patients whose histories were carefully recorded. Many of these patients had been under the observation of the authors from the time of injury.

Urinary function in these patients appeared in one of the 5 following forms (1) early return to normal micturition (2) eventual return of partial voluntary control of micturition (3) involuntary dribbling of urine, or the frequent uncontrolled passage of very small amounts of urine (4) absolute retention (a less common situation), and (5) automatic or reflex micturition entirely free of any voluntary effort on the part of the patient. The early care of the bladder is of utmost importance to the future function of the bladder and therefore not only to the completeness of the patient's possible degree of rehabilitation but to the very preservation of his life. Such measures as intermittent catheterization, manual expression of the bladder, penile urethrostomy, suprapubic cystostomy, distention and overflow, and other such anphysiological and unsafe measures are to be condemned and avoided wherever possible. Even the exigencies of war do not excuse their use in most instances. Every effort must be made to effect the automatic emptying of the bladder for only under such conditions will the urinary tract remain as free of infection as is possible. The authors state that the effect on the patient's morale of a change for instance, from a suprapubic tube to automaticity is spectacular.

Automaticity was found to have developed in the authors' patients following a complete lesion at any level within the spinal cord or cauda equina. It developed in 14.3 per cent of the patients with cervical cord injuries, in 34 per cent of those with thoracic cord injuries and in 16.4 per cent of those with lumbosacral injuries. It seemed to appear earlier and with greater efficiency in the presence of lesions between the levels C-7 and Th 5. Severe altered reflex activity, sepsis from an infected bladder or bed sores, and general inanition may spell the termination of automatic micturition. Furthermore, automaticity will develop only when there is no mechanical bladder neck obstruction and when the sphincter is capable of reflex relaxation. For that reason resection of the bladder neck has been found to be a distinct aid in many patients. Extravesical stimuli are an aid but not a necessity to the development and maintenance of automatic micturition.

Nerve Lesions in Bone Injuries. HERBERT JOHN SEDDON. *J. Am. M. Ass.*, 1947 135 691

Even in his extensive personal experience Seddon feels that the prognosis may be very uncertain when nerve injury complicates a closed injury of certain long bones. He points out that while it is true that a large number of such injuries result in spontaneous recovery of the nerve operation may eventually become an absolute necessity and when the decision is finally made for surgical intervention the most favorable time for such treatment has already passed. On the other hand routine exploration is not justified.

The author has chosen to classify these injuries into three categories. In the familiar transient paralysis, neurapraxia, motor loss is usually complete, sensory loss is incomplete and the reaction of degeneration is absent. Recovery is as expected spontaneous. When neurotmesis exists there is complete disorganization of the nerve, even complete severance and recovery will come about only through surgical repair. In the event of axonotmesis, the Schwann tubes are preserved but the axons are ruptured and in such cases delayed but eventually spontaneous recovery will occur. The major problem therefore is to know which of these two latter types of injury is present in any particular bone nerve lesion.

When injury has been caused by a bony spike the lesion usually is well localized in the nerve but in many severe traction injuries the actual injury to the nerve may extend over many centimeters. The injury may be so severe and over such a great distance in such major traction injuries that, while anatomic continuity exists, intraneural scar formation reduces the lesion essentially to one of neurotmesis. Clinically there may be some difficulty in distinguishing between a traction lesion and a localized direct injury, but if the extent of the paralysis indicates that the lesion in the nerve exists proximal to the site of the fracture then only a traction type of injury can exist. In such a case the prognosis is grave as apparently nothing less than heroic surgical measures could offer any help.

Fractures of the shaft of the humerus most commonly involve the radial nerve and in such injuries compression or division of the nerve by a bony fragment is the rule.

Isolated axillary nerve injuries are usually due to traction and the prognosis is uncertain.

JOHN MARTIN M.D.

Experimental Research on Nerve Ligation (Recherches expérimentales sur les ligatures des nerfs). M. P. CHENILLEAU. *Bordeaux chir.*, 1947 No 2 p 60

The author using rabbits has recently shown the effects of ligating the free cut end of the central stump of a peripheral nerve such as might be done at the time of amputation of an extremity. He points out that older surgeons as Velpeau and Dupuytren

cautioned specifically against the inclusion of large nerve trunks in the neurovascular bundles at the time of amputation because of the severe pain or other "grave accidents" which might befall the patient after such treatment.

Quite on the contrary, Chenilleau has shown that he can prevent trophic ulcers in animals following the resection of 1.5 to 2 cm. of the sciatic nerve, and has seen evidence of painful neuromatous reaction after several months if at time of operation, he ligates the central stump approximately 1 cm. from its end. Control animals without such ligation have been studied together with those in which the nerves were ligated with catgut, and in others with a linen thread. Invariably the animals not treated by ligation suffered much more severe trophic ulcers than those ligated with catgut, and those ligated with linen had little or no trophic disturbance and were much better than the animals treated with catgut. Good photographs of the animals bear out these statements. The author believes that the linen thread obviates the formation of a neuroma locally and that a catgut ligature tends to do the same thing but that the local reaction produced by the catgut minimizes the otherwise good effect of the ligature. The linen, he feels, exerts a regulating and order-producing effect on the terminations of the severed neurones, and thus prevents the wild disorganization of the untreated nerve end. There is, likewise, clinical evidence at hand to support his findings in animals.

JOHN MARTIN, M.D.

Rate of Regeneration in Human Peripheral Nerves: Analysis of the Interval between Injury and Onset of Recovery SYDNEY BOWENLAND, *Arch. Year Psychiat. Chic.*, 1947 58: 25

There are two distinct events in the functional regeneration of a peripheral nerve: (a) the axon regenerates anatomically, and (b) the axon matures functionally after myelination and increase in diameter of the fiber. The second event follows the first and proceeds at a slower rate, but both slow up progressively as the axon tip moves farther from the cell body. Thus the initial rate is faster when the lesion is close to the parent neurons and slower when the lesion is farther distal.

When the nerve is not actually severed but there is a destruction of the axon from crushing or contraction of the nerve, the rate of functional maturation over the proximal portion of the nerve (arm and thigh) is in the vicinity of 3 mm. per day and slowly diminishes to approximately 0.5 mm. per day over the distal portion (hand and foot). When there is division and retreat the rate of functional maturation

is somewhat slower. The rate of regeneration is the resultant of (a) central forces provided by the cell body and (b) the peripheral resistance against which the central growth forces act. The rate in the initial stages of recovery is faster with high lesions, since these are closer to the parent neurons, while at the lower levels, the initial rate is slower because of the influence of the central forces of growth is weaker.

It is believed that repair is adversely affected by wound infection and scarring only when these factors add to the severity of the nerve lesion.

DORRIS ROSE, M.D.

SYMPATHETIC NERVES

Procaine Block of the Sympathetic Nerve in the Study of Intractable Pain and Circulatory Disorders. JAMES C. WINTER, *Surg. Clin. N. Am.*, 1947 7: 863

The diagnostic injection with procaine of various parts of the autonomic nervous system has led not only to accurate diagnosis and, in many instances, to the accurate prognosis to be expected from surgical treatment, but also has indicated the true anatomy and physiology of previously poorly understood pathways for the transmission of certain visceral sensory impulses. The usefulness of sympathetic block in testing for the effects of surgery in such diseases as Raynaud's syndrome, causalgia, and other intractable pain states is well recognized. Through such testing we have come to realize the value of sympathectomy at the proper levels for angina pectoris, the pain of aortic aneurysm, intractable pain of the gastrointestinal tract and the pancreatic and biliary tracts, painful osteoporosis, and certain types of painful amputation stumps. Such preoperative blocking of the sympathetics has been found to be of less prognostic value in thromboangiitis obliterans and arteriosclerosis. It is through the effectiveness of paravertebral block that surgeons have been able to develop methods of viscerosensory denervation which carry a minimal risk and do not disturb cutaneous sensation. For instance, it has been shown many times that the pain of angina pectoris can be obliterated by posterior rhizotomy on the first through the fourth thoracic nerves but the same control of pain can be obtained by resection of the upper three or four thoracic sympathetic ganglia.

Several excellent diagrams, typical of articles by this author demonstrate the techniques of sympathetic block as well as certain of the autonomic pathways in the diseases discussed.

JOHN MARTIN, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Cystic Disease of the Breast: Human and Experimental B D PULLINGER. *Lancet* Lond., 1947
2 567

There are three outstanding questions concerning cystic disease of the breast. These are (1) the mode of origin (2) the cause and (3) the relation to cancer.

According to Cheate and Cutler (1941) 20 per cent of all mammary cancer begins in cystic breasts. This is an association and not necessarily a causal relationship.

Ovariectomized virgin young and mature female mice of two strains (R3 and C3H) were given single physiologic doses of two naturally occurring estrogens (estradiol and ketohydroxyestrin) in 400 microgram doses. (There are some data to indicate that the dose used was excessive even from the point of view of causing a pathological rather than a physiological response.) The response to the 400 microgram dosage was similar for both estrogens.

With the R3 mice some breast acini were ballooned out and became cystlike—a pathological adenosis with secretion and distention. Estrogens alone produced this change which according to previous knowledge should have required the combined action of estrogen, progesterone and probably a lactogen.

With C57 black mice a typical normal mammary gland response to both estrogens was obtained. It is clear from this that there is a strain difference in breast response to estrogen in mice. Two high mammary cancer incidence strains (C3H and Strong A) responded normally, e.g. there was no increase in cancer.

In the mouse with responsive inbred strains a peculiar reaction is found in every part of the gland. Hybrids of two strains (R3 which reacts vigorously and C57 black which reacts by duct outgrowth only) were tested and a part of each mamma reacted like one parent, part like the other, the proportion being about half and half. This dual response suggests that the localization of cystic response is hereditary. Mongrel mice showed comparable responses. There are apparently specially sensitive portions in the mammary epithelium. The distention in rodents appears to be passive due to rapid secretion of a milky fluid before which the walls of the ducts and acini appear to give way.

Cystic disease in the human being is a disease *sensu generis* and not a part of a cancer process. Geschickter (1945) believes the origin of cystic disease to be estrogen and progesterone imbalance. Ingley (1942) emphasized the individual difference in anatomical types of glands. The occurrence of localized cystic disease under the conditions of these mouse experiments strongly favors Ingley's interpretation of the origin of localized cystic disease. The assumption of a difference in reactivity of epithelial cells in

different parts of the duct and acinar system in both human beings and mice would resolve the divergent opinions.

Evidence of inheritance of cystic disease in human beings has not been collected. The decisive factor appears to be not merely an excess or imbalance of estrogen but an atypical response of mammary epithelium. This response predisposes to mammary cancer in mice when the cancer is activated by the milk tumor agent. Its relationship to clinical carcinogens has not been determined.

FRANK B. QUEEN, M.D.

Radical Mastectomy: Prognosis after Survival for 5 Years. ARTHUR B. MCGRAW. *Arch. Surg.* 1947 55
292

The close observation and study of the author's series of patients with cancer of the breast, especially of those who survived operation 5 years or more has in every way strengthened his conviction that a thoroughly radical operation is the only procedure at present giving such patients a good chance of long survival. He believes that such an operation should be undertaken whenever it can be performed with technical adequacy unless coexisting metastases are so advanced or widespread and the patient's expectancy of life is clearly so short as to make operation futile.

One hundred and seventy-seven patients (43 per cent of all cases) survived the 5 year period.

JOHN J. MALONEY, M.D.

TRACHEA LUNGS AND PLEURA

Bagasse Disease of the Lungs. DAVID V. LEMMON, WENDELL G. SCOTT, SHERWOOD MOORE and A. LOUIS KOVEN. *Radiology* 1947 49 556

Bagasse disease of the lung or bagassosis, is a pulmonary disorder brought about by inhalation of sugar cane after it has been crushed and the juice extracted. Only from 30 to 40 cases have been reported since it was first described in 1941 by Jamison and Hopkins.

The disease occurs only in people exposed to the inhalation of dry bagasse dust. This product is used in the manufacture of acoustical and thermal insulating building materials and in the production of refractory brick. The disease is restricted to communities which cut and process sugar cane (Louisiana or Cuba) manufacture building board (England) or make refractory brick (Missouri).

The symptoms and clinical course vary with the length of exposure and density of inhaled dust. About 2 months of exposure to the dust is necessary although the time varies from 3 weeks to 2 years. The disease is an acute febrile illness accompanied by extreme dyspnea, weakness, and a persistent cough with scanty mucoid sputum. The onset is in

idious. Cyanosis appears in only the most severe cases. The patients appear to have a severe bronchiolitis and pneumonia. Patients with long exposures are critically ill. In a series of 24 cases collected by Hunter there was a mortality of 83 per cent. However most of the patients who have had shorter exposures and lighter concentrations of the dust contract a less severe form of the disease which clears in from 2 to 6 months.

The fever usually ranges from 37 to 40 degrees and persists for 2 to 3 months. The pulse and respirations are increased. Percussion of the chest reveals a slight decrease in resonance. Breath sounds are normal and whispered voice may be increased. Moist crepitant rales are heard throughout both lungs. In severe cases the white blood cells may reach 16 to 20,000 with a shift to the left and an increased sedimentation rate. An eosinophilia (3.5-8%) is usually present. Blood chemistry and sputum cultures are negative.

The x ray findings are not characteristic and depend also on duration and concentration of exposure. In severe cases a fine punctate infiltration throughout both lungs is seen. These areas become nodular as they clear. Areas of early consolidation accompany the infiltration. The x ray changes seem to be reversible after a period of 3 months. In from 5 to 6 months the lung fields appear normal. Patients exposed to shorter and lighter concentrations show only a fine granular lace network of infiltration throughout both lungs which is heavier at the hilum in the left lower and middle lung fields.

Only 3 cases have been examined pathologically. They showed a fibroblastic reaction of the interstitial tissue with small needlelike spicules of an irregular foreign material (2 to 8 micra) imbedded in the pulmonary tissue. The large alveolar cells with foamy cytoplasm were more numerous. The pulmonary changes were those of an organic pneumoconiosis.

The etiology of bagassosis is obscure and it has never been reproduced in experimental animals. Whether the pathological reaction is due to fungi, bacteria, or a virus associated with the dust, or to an allergic response to the bagasse or its possible infectious agents or their products, or to some chemical or physical property of the dust, or any combination of these has not been determined.

There is no specific therapy the patients are treated symptomatically. Oxygen has afforded relief from dyspnea. Penicillin and "sulfa" drugs have had little effect.

Three case reports complete with roentgenograms are presented.

ROBERT R. BROWNE M.D.

The Pathogenesis of Bronchiectasis. TRACY B. MAILLORE *N England J M* 947 37 795

Five factors—chronic bronchial infection, congenital abnormalities of the bronchial tree, bronchostenosis, pulmonary telecystasis and pneumonitis or its sequelae, pulmonary fibrosis—are potential agents in the etiology of bronchiectasis. Of these, congeni-

tal cystic disease and bronchostenosis are comparatively uncommon.

Bronchial inflammation alone is rarely an effective factor, but in combination with atelectasis or pneumonitis it accounts for most of the characteristic features of the disease.

SAMUEL KATZ, M.D.

HEART AND PERICARDIUM

The Pathophysiology of the Cause of Death from Coronary Thrombosis. GORDON MURRAY *Am Surg* 1947 126 33

A condition of paradoxical systole has been demonstrated experimentally in the hearts of animals following coronary occlusion. This state is accompanied by a fall in the blood pressure and diminished cardiac output.

Following resection of the infarcted area in the heart, there is an improvement in the blood pressure and in cardiac output. The technique is described in detail.

It has been demonstrated that, compared with a control group of animals, the prospects of survival are 80 per cent. Operation was done on 25 animals.

It was suggested that the best treatment of acute coronary occlusion in the human being in selected cases might be immediate surgical operation. This would provide:

1. A better chance of survival from the effects of a severe and large infarct from a major occlusion.
2. A cure of the patient from an infarcted area of the heart which would eliminate the dangers of acute rupture, aneurysm, and subsequent rupture. It would remove all the effects of a coronary occlusion.

JOHN J. MALONEY M.D.

ESOPHAGUS AND MEDIASTINUM

Congenital Atresia of the Esophagus with Tracheoesophageal Fistula: A Report of 6 Cases. JOSEPH A. FERROULT, WILLIAM H. FLEMING, and THORBORN R. WEITAKER. *Arch Otolaryngol*, 947 46 668.

Prior to 1930 congenital atresia of the esophagus, with or without tracheoesophageal fistula, was uniformly fatal. There have been 37 successful surgical recoveries among 464 cases reported in the literature, consequently the mortality has been reduced to 74 per cent.

Vogt classified these defects as (1) complete agenesia or absence of the esophagus, (2) atresia without fistulas and (3) atresia with fistulas. In the latter group are (a) a fistula between the trachea and upper esophageal segment, (b) a fistula between the trachea and lower esophageal segment, and (c) a fistula between the trachea and both esophageal segments. The last type comprises 80 per cent of all atresias found at autopsy. Associated congenital anomalies are encountered in as many as 50 per cent of the cases.

A patient with esophageal atresia and tracheoesophageal fistula usually appears normal at birth ex-

cept for a slight increase in mucus in the mouth and throat. Physical examination may be normal, or moist rales may be audible particularly in the upper lobe of the right lung. When attempts are made to feed the child, there is difficulty in swallowing associated with choking dyspnea and cyanosis. The mucus reaccumulates and rales increase as saliva or feedings are aspirated. Air will be found in the stomach if a lower tracheoesophageal fistula is present.

A more definite diagnosis can be made if a catheter is passed and meets an obstruction 10 to 12 cm from the alveolar margins. A small amount of iodized oil can be instilled under fluoroscopic guidance. When necessary bronchoscopy may aid in diagnosis.

Unless there is surgical intervention the infants die of pneumonia and starvation. Exploratory thoracotomy is the only definite method of determining the possibility of direct anastomosis of esophageal segments. Any operative treatment is designed to prevent aspiration pneumonia to provide some means of feeding, and to prevent gastric contents from being regurgitated into the trachea. Whenever possible a direct anastomosis is carried out. If this is not feasible the tracheoesophageal fistula is ligated, the upper esophageal segment is exteriorized and a gastrostomy or esophagostomy is performed with subsequent construction of an anterior thoracic skin tube to re-establish continuity. Haight in one operative series, reported direct anastomosis was feasible in 70 per cent of the cases. The thin friable nature of the lower esophageal segment makes it extremely difficult to make a direct anastomosis.

Only 2 cases have been reported in which the continuity has been restored by an antethoracic esophagus. Surgery is well tolerated if it is performed early before starvation or pneumonia develops. Post operative periods are stormy with episodes of cyanosis, dyspnea, fever, dehydration and pulmonary complications.

The authors review the histories of 6 cases seen at the Mercy Hospital, Pittsburgh, Pennsylvania, all of which terminated fatally.

From the experience gained in these cases the authors learned that the primary diagnosis may be overlooked while treating the patient for the pulmonary complications. (2) the diagnosis may be confused with pyloric stenosis, (3) the diagnosis must be made early and surgical intervention be prompt to save these patients. (4) iodized oil instead of barium sulfate should be used for diagnostic purposes. (5)

closure of the fistula between the trachea and the lower esophagus is essential to prevent regurgitation of stomach contents into the trachea and (6) frequent aspirations of the pharynx will prevent spilling over from the obstructed upper segment of the esophagus.

ROBERT R. BIGELOW M.D.

Congenital Atresia and Tracheoesophageal Fistula: 4 Consecutive Cases of Successful Primary Esophageal Anastomosis WILLIAM P. LONG
MIXE, JR. *Arch Surg.* 1947 55 330.

Four consecutive patients with tracheoesophageal fistula and esophageal atresia have survived ligation of the fistula and primary anastomosis of the esophagus. They are now taking all feedings by mouth and are gaining weight satisfactorily. One of these patients weighed only 3 1/2 pounds at the time of operation. Certain features of the diagnosis, the operative technique, and the postoperative care are discussed. The importance of the early recognition of the condition by the attending physician is emphasized.

JOHN J. MALONEY M.D.

MISCELLANEOUS

Injuries of the Chest. BRIAN BLADES *J Am M Ass.* 1947 135 818.

The advances made in the management of wounds of the chest during the war have not been the result of technical improvements but have resulted from judicious timing and selection of surgical procedures.

The absolute necessity for whole blood in the treatment of shock, rather than plasma, and the danger of the excessive use of morphine in shocked patients have been definitely established.

In cases of fractured ribs control of thoracic pain by paravertebral injections of procaine hydrochloride should in great part, replace strapping of the chest. In traumatic wet lung, also paravertebral procaine hydrochloride block is of great value.

In cases of hemothorax early aspiration helps to effect complete re-expansion of the lung and conservation of cardiopulmonary function. In cases of clotted hemothorax or fibrothorax decortication of the lung has given brilliant results. This operation involves an open thoracotomy for the removal of the fluid and clot from the pleura, and excision of the fibrous corset of tissue which holds the lung in a collapsed position.

SAMUEL KAHN M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

A Case of Strangulated Internal Hernia at the Age of 91 in the Femoral Inguinal Region. JAMES A. ROSS and J. W. A. DE KWORTU. *Br J Surg* 1917 35 9

This is a report of a 91 year old woman who was admitted to the Royal Infirmary, Edinburgh, with intestinal obstruction. At operation a loop of small intestine was found to be lodged in the mouth of a peritoneal pouch which lay transversely in the right iliofemoral opening lying superiorly. The femoral wall below the pericardial region and represented the femoral inguinal region or loss of Bicus. The nature and morphology of this peritoneal space is described.

LEWIS W. (1918, M.D.)

Repair of Sliding Inguinal Hernia through the Abdominal (Larouque) Approach. LAROUQUE. *Ann Surg* 1917 35 20

Cognizance of the infrequent use of the abdominal approach in the treatment of sliding hernia motivated this review of the literature and description of the technique. The poor understanding of sliding hernia is illustrated by the low incidence variously reported as being from 1 to 3 per cent. The diagnosis is usually made after the sac is exposed or opened.

The literature indicates that the hernia is usually repaired through the inguinal approach. Among 501 collected cases, the mortality was 2.8 per cent. The death occurred when the colon was resected. Most authors call attention to the danger of injury to the blood supply or to the wall of the bowel when freeing the sac from the bowels. Attention is called to the fact that fixation of the bowel (sigmoid or cecum) to the wall of the sac is not caused by inflammatory adhesion but by normal fixation of the bowel to the peritoneal wall which has been pulled over some way, has descended to become a part of the wall of the hernial sac.

The first use of an opening into the abdomen above the inguinal repair to reduce this type of hernia was reported in 1907 by Fiaschi and many others have reported variations of the procedure since that time. Larouque in 1909 and in 1924 described the technique used and described in detail by the author.

The usual inguinal incision is made. The sac is exposed and dissected free from the cord, opened on its anterior surface, and the colon is thus exposed. Through the same skin incision the internal oblique and transversus abdominis muscles are opened 1 inch above the internal ring, care being taken to avoid the iliohypogastric nerve. The muscles are retracted and the peritoneum is opened transversely as is the overlying transverse fascia. The contents of the hernia can be visualized. They enter the internal ring from above. The colon and peritoneum are then

completely freed from the cord structures and are drawn back into the abdominal cavity when it becomes apparent that the anterolateral wall of the sac is the lateral leaf of the mesocolon. This peritoneum is then sutured after the excess is cut away. The resulting suture line closes the lateral leaf of the mesocolon. A run across the floor of the inguinal region to close the internal ring, and within the inferior margin of the peritoneal opening in the abdominal cavity. The transversalis fascia is then closed and the internal oblique and transversus abdominis are sutured. The inguinal canal may then be repaired in the usual manner.

FREDERICK C. HOWELL, M.D.

GASTROINTESTINAL TRACT

Acute Volvulus of the Stomach (Volvulus agilis de estomago). CARLOS SILVEIRA BRAGA and LUIZ V. M. TORRES. *Rev med Rosario* 1917 37 504

The authors report a fatal case of gastric volvulus in a 39 year old woman with old rheumatic heart disease. She complained for many years of a vague undetermined postprandial distress unrelieved by food intake. Suddenly she developed an epigastric nonirradiating pain almost immediately after supper and continuous emesis.

Röntgen examination of the stomach disclosed an obstruction at the level of the antrum. At operation it was found to be a gastric volvulus in a longitudinal axis with total occlusion of the pylorus and partial occlusion of the cardia.

A congenital defect with lack of peritoneal coalescence and the characteristics of a "roentertum communi" was found to be the basis for the volvulus.

WILLIAM F. RECKITT, M.D.

Carcinoma of the Esophagus and Cardiac End of the Stomach. LLOYD L. LEE. *Arch Surg* 1917 35 20

Four cases of total gastric resection by the trans-thoracic approach and a case of resection of the esophagus by the same approach are presented. Of the 6 patients, only 1 patient who had had a resection of the esophagus, was alive at the time the authors article was prepared. The cases illustrate many of the pitfalls that may be encountered in the surgery and after care as well as the discouraging high mortality despite the most careful preparation and long hours of meticulous surgery.

Controlled respiration anesthesia with cyclopropane and chemotherapy to control infection, are the recent adjuncts that have opened up this field of surgery. Phemister is credited with the observation that the trans-thoracic, transdiaphragmatic approach gives excellent access to the stomach. Kirschner discovered that the entire stomach could survive on the blood supply from the arteries at its

pyloric end alone. Garlock pointed out that if the gastrohepatic and gastrocolic ligaments and the left gastric artery were divided the stomach could be converted into a long muscular tube which when the diaphragm had been divided could be stretched almost to the top of the pleural cavity.

The author describes the manner of freeing the esophagus for complete removal of that organ the manner of making the anastomosis between the esophagus and either the stomach or jejunum and the sutures necessary between stomach and pleura to suspend the stomach high in the apex of the chest cavity.

The necessity for exploring a carcinoma of the stomach through an abdominal incision to determine the operability prior to making the transthoracic approach is described. It is also pointed out that the thoracic incision may be extended across the costal margin and upper abdomen when better access to the pyloric end of the stomach is mandatory. The necessity for correcting anemia, electrolyte imbalance and nutritional deficiencies is stressed.

FREDERICK C. HORNELL, M.D.

An Exceptional Indication for Gastric Resection (Un'una indicazione eccezionale alla resezion gastrica) ANTONIO ANZANI Arch Ital Med Exp 1947 13 284

The author refers to a case of habitual vomiting due to gastric hypotonia and dyskinesia associated with esophageal and cardiac (gastric) atony in an individual of asthenic habitus and impaired development who presented a grave picture of inanition.

The patient was operated upon November 3, 1945. Gastric resection was performed with a decrease of the symptoms which has persisted to date. The pathogenesis is discussed; it is related to the dystonia and dyskinesia of the esophagus, the cardia and the stomach and associated with intrinsic and extrinsic disturbances of innervation.

LEONARDO FRONZONI, M.D.

The Absorption of Iron after Gastric Resection (L'assorbimento del ferro nel gastro-resecati) ULIO COBRICCI and ALDO BOLLETTI Ann Ital Chir 1947 24 261

The authors have studied the condition of 15 patients following gastric resection (7 Hofmeister, Finsterer, 4 Reichel, Polya, 2 Moynihan, Lucinelli, 1 von Hacker) for periods ranging from 6 days to 5 years and 9 months.

About 65 per cent of the patients presented an erythrocytopenia which was grave in one case. The hemoglobin was below normal in all cases and varied from 50 to 78, a striking hypochlorhydria was noted in all cases.

The authors conclude that the anemia is proportional to the amount of stomach resected and is accompanied by a hypochlorhydria which is more or less striking—achlorhydria in some patients and in 1 histamine resistant. The relation of iron absorption to gastric acidity is not to be considered as

cause and effect. It may act indirectly in that digestive processes are altered by its diminution and thus absorption is more difficult.

Two hypotheses are offered:

1. The deficiency in these individuals of a particular factor contained in the mucosa of the stomach which is diminished or absent following gastric amputation. This factor must act either on the endogenous metabolism of the metal favoring the fixation and maintenance in the organism or by stimulating erythropoiesis. It does not seem to have any influence on the intestinal absorption of iron.

2. A grave alteration in the digestive processes through the new anatomicophysiological conditions.

LEONARDO FRONZONI, M.D.

Principles Governing Total Gastrectomy: A Report of 41 Cases. GEORGE T. JACK, CORDON MCNEER, and ROBERT J. BOONER. Arch Surg 1947 55 457

The abdominal surgeon has by necessity taken up total gastrectomy in his attack on cancer of the stomach. The purpose of the operation is curative but unfortunately in most cases the results are only palliative. Total gastrectomy means removal of both the pylorus and the cardia and on examination the removed portion will show a bit of the esophagus at one end and a part of the duodenum at the other. The first total gastrectomy was performed in 1884 by Connor and the first successful one by Schlatter in 1897.

The well planned total gastrectomy is both an excision of the entire stomach and a dissection en masse of the related lymph nodes. The greater omentum, the lymphatics and nodes along the greater curvature, the nodes of the left gastropancreatic fold, the juxta-cardiac nodes, the right gastropyloric nodes, the infropyloric and retropyloric nodes, the lymph nodes of the lesser curvature, the gastrohepatic and gastrosplenic ligament and the nodes along the celiac axis should also be removed. If necessary the spleen and the peritoneum of the lesser peritoneal sac may be included in the dissection.

The authors report 41 cases of total gastrectomy, 37 for cancer, 2 case for sarcoma and 3 cases for benign lesions. There were 12 females and 29 males with an average age of 54 years and 5 months.

Pain was the initial complaint in 20 patients, with anorexia, weakness, indigestion, vomiting, belching, dysphagia, nausea, loss of weight and rapid satiation as the original complaints in others. Seventy-five per cent of the patients had symptoms for a year or less. This is similar to the percentage reported in a collective review of 162 patients. The average duration of symptoms for a series treated by subtotal gastrectomy was 16 months.

The indications for total gastrectomy are (1) location of the lesion, (2) limits plastica (4 cases of the reported series), (3) lymphosarcoma, (4) malignant leiomyoma or leiomyosarcoma, (5) multiple polyps, and (6) gastric ulcer high on the lesser curvature.

Fluoroscopic examination of the stomach is the most important and easiest way to determine the

extent of invasion of the tumor. Esophagoscopy may be necessary to show the upward involvement of the cardia and esophagus. The flexible gastroscope can be of value when the x ray studies show freedom of the cardia.

Patients are hospitalized 5 days before surgery and put on a low residue high protein, forced diet, liquid if necessary. Medical evaluation of the cardi-

vascular status is obtained. Restoration of the hemoglobin, red cell count, and serum proteins is carried out. Gastric aspiration and lavage with one tenth normal hydrochloric acid are daily procedures. The patients are sent to the operating room with an indwelling nasal Levine tube in place.

Continuous spinal anesthesia is the authors' choice and penthal is given intravenously for restlessness and apprehension.

In only 1 case was transthoracic total gastrectomy performed as the subdiaphragmatic approach is preferred when the distal esophagus is not involved.

Gastrointestinal continuity was restored by esophagojejunostomy in all but 1 case in this case esophagoduodenostomy was done. The latter procedure with its increased tension and higher mortality has since been abandoned.

When the blood is ope ed careful widespread exploration is necessary to determine the operability. If the lesion is resectable the right gastric, the gastroduodenal and the right gastroepiploic vessels are ligated and the mentum is resected from also g the transverse colon. The duodenum is divided and incised with the Kerr Parker closure. The coronary ligament of the left lobe of the liver is cut and the remainder of the stomach mobilized. The authors prefer a long loop antecolic jejunal anastomosis. A 3 layer closure—an outer row of black silk mattress sutures and an inner continuous gut suture is used. Previously prepared diaphragmatic peritoneal flaps are sutured over the anastomosis and tension is released by suturing the jejunum to the diaphragm laterally. An indwelling Levine tube is placed in the distal jejunum for feeding purposes. In 83 per cent of the authors' cases a jejunojejunostomy was performed.

Transfusions, oxygen blow bottles, chemotherapy early ambulation early feeding through the Levine tube, parenteral fluids and supplemental vitamin therapy are essential in the postoperative treatment.

In the authors' series of 41 cases there were 13 operative deaths (31.7%). Causes of death were pulmonary complications in 6 cases, and cardiac failure and peritonitis in 3 cases each.

Of the nonfatal complications, atelectasis (6 cases) pneumonia (9 cases) abdominal fistula (8 cases) serious wound infections (6 cases) and postoperative hypoproteinemia (9 cases) were the most frequent.

Following total gastrectomy there is remarkably little alteration in nutrition. There is a disturbance of fat absorption, an increased loss of fecal nitrogen, a more rapid absorption of glucose and often a hypoproteinememia. Only 3 patients had moder-

ate anemia of the normochromic normocytic type. Nearly all of the patients were unable to gain weight.

On December 1, 1945 there were 11 living patients in this series. 7 of the patients who had had cancer were living and well, and 1 was living with evidence of recurrence. 3 patients were living after resection for benign lesions. The longest survival was 41 months. None of these showed any evidence of lymph node metastases at the time of operation. Five of 37 patients survived or are living 3 years after operation, an average of 13.6 per cent.

The 17 patients who survived operation but died later survived for an average of 18 months. Fourteen died of their original cancer. The average duration of life in this group was doubled if no lymph node metastases were found at the time of the original operation.

ROBERT R. BROWNE, M.D.

The Role of Hostility in the Pathogenesis of Peptic Ulcer. THOMAS S. SAADE, ERWIN LUTIK, JOSEPH B. KREMER, and WALTER LINCOLN PALMER. *Psychosomatic M* 947 9-33

The interrelationship between psychologic and physiologic processes in the functioning of the human stomach has been known since Beaumont's work in 1833. Alexander's recent work has provided considerable psychologic insight into the role of emotional factors in peptic ulcer.

Although the increased secretion of acid gastric juice in the presence of anger has long been known, little is known of its importance in the pathogenesis of peptic ulcer.

The authors present a case of peptic ulcer in which it was demonstrated that anger stimulated the production of a large volume of gastric juice with a high free acid. This effect was produced after a period of complete inhibition of gastric acidity by enterogastrene. After bilateral vagus section the stimulating effect of anger was abolished.

In order to account for the role of anger and fear in gastric function a theoretical formulation emphasizing the specific type of correlation between these affective states and feeding is presented. This differs from Alexander's concept that the stimulus is represented by a conflict situation. There is a close emotional association in the infant between anger (crying) and the natural result (receiving food) on the one hand, and between fear and the feared result (not receiving food) on the other. In the course of normal development this equation is weakened or broken. In some ulcer patients and in some normal individuals this association may persist and may then find its expression through the process of "repressive innervation" (the recapitulation of an infantile pattern of physiologic responses to certain emotional stimuli mediated by nervous pathways).

The etiology of peptic ulcer is complicated and probably includes a multiplicity of somatic and psychologic factors. In considering psychologic factors we must assume that anything which increases the gastric secretory and motor activities may cause an ulcer. On this hypothesis, hostility is a potential

pathogenic agent for peptic ulcer. Regardless of the difficulty in estimating its importance quantitatively it must be considered to play a major role.

ROBERT R. BIGGLOW M D

The Place of Surgery in the Treatment of Peptic Ulcer. The Hamilton Russell Memorial Lecture. SIR HERMANCE O'CALLAGHAN, *Austral N Zealand J Surg* 1947 17 3

The author presents a long philosophical discussion of the physiology of the stomach, particularly as related to peptic ulcer, the symptomatology of peptic ulcer, and the author's evaluation of current trends in the operative treatment.

It is emphasized that gastric and duodenal ulcer are separate disease entities despite some similarities. Gastric ulcer is an old disease (becoming less common) that occurs in the undernourished and underprivileged all over the world. It occurs equally in the sexes usually in the long low stomach of poor tone, slow emptying and a low or normal acidity. Oral sepsis and food of poor quality or insufficient amount often seems in part responsible. Gastric ulcers undergo malignant degeneration in about 5 per cent of cases but apart from this are seldom fatal, however, once they become chronic they rob life of all its pleasures. Causes of persistence probably lie in the stomach itself, the avascular scar, and the adhesions.

Duodenal ulcer is a new disease. It is limited to civilized communities and the more progressive members of those communities and is becoming commoner. It occurs more frequently in men, brain workers of the restless intellectual worrying type, but its occurrence in women is increasing as they take over the activities of men. It occurs more often in the high transverse type of stomach and the onset and recurrences are frequently associated with periods of worry, overwork, and frustration. Surgery for duodenal ulcer is the surgery of the complications as contrasted with gastric ulcer in which operation is performed because of persistence.

The desirable treatment of gastric ulcer is gastrectomy which at one step removes the symptoms, the ulcer, and the dominant factor causing the ulceration. Vasoligation of large numbers of the arteries of the stomach just short of gangrene as a method of reducing the acidity is dismissed because gangrene and slough has been a complication and otherwise the operation is frequently a failure because of inadequate ligation.

Vagus section is thought to be of value but is considered inadequate because it only affects the psychic phase of gastric acid secretion leaving the prolonged effect of the hormonal stimulation from the retained pyloric end of the stomach.

The exclusion operation in which the pylorus with the ulcer is allowed to remain distal to the resected area of the stomach is also condemned because it leaves the hormonal secreting portion of the stomach. When this procedure is necessary because of technical difficulty in removing the ulcer area the

mucous membrane as far as the pyloric ring should be removed.

The three roots from which gastric acidity springs must be removed for adequate treatment of duodenal ulcer. First, the zone of high gastric secretion should be completely removed, that is the area of high convoluted mucous membrane of the body should be removed leaving only the low acid secreting mucous membrane of the fundus. Second, a high proportion of the vagal fibers should be removed. Third, all of the pylorus or at any rate all of the pyloric mucous membrane should be removed.

The author prefers for duodenal ulcer a gastrectomy at the level of the lower end of the fundus with a retrocolic valvular type of anastomosis with the jejunum. He straightens out the duodenojejunal junction by freeing the ligament of Treitz. The anastomosis is isoperistaltic, is entirely superior to the mesocolon and falls in a smooth curve to avoid obstruction and resultant duodenal blow-out.

FREDERICK C. HORBEL, M D

Symposium on Vagotomy for Peptic Ulcer. Experimental Observations. HENRY N. HARKINS, DONALD H. HOOKER, T. CRANDALL ALFORD JR., JOHN CALLANDER and Others. *Bull Johns Hopkins Hosp* 1947 81 9

The authors performed 6 different experiments on the production and prevention of peptic ulcers.

1 They attempted to produce histamine ulcers in the rat.

2 They used aqueous benadryl solution in an attempt to prevent histamine in beeswax ulcers in the guinea pig.

3 They used benadryl in beeswax in an attempt to prevent histamine in beeswax ulcers in the guinea pig.

4 They used vagotomy in an attempt to prevent histamine in beeswax ulcers in the guinea pig.

5 They used vagotomy to prevent pyloric ligation induced ulcers in the Shay rat.

6 They studied the influence of vagotomy on the development of jejunal ulcers in the Mann-Williamson dog.

The various experiments warranted the following conclusions:

1 Benadryl (per os or subcutaneously in aqueous or in beeswax in-oil solution) does not prevent histamine-provoked peptic ulcers in guinea pigs within the limits of dosage and conditions of the experiments reported.

2 Vagotomy does not prevent histamine provoked ulcers in guinea pigs within the limits of dosage of the drug as used.

3 Vagotomy prevents the development within 24 hours of ligation induced ulcers in rats and lengthens the life of such animals.

4 Vagotomy lessens the acidity and volume of the accumulated gastric fluid following pyloric ligation in rats, but neither of these factors alone explains the beneficial effect of this procedure.

5 Esophageal ligation with or without vagotomy reduces the incidence of pyloric ligation induced ulcers in rats, but does not prevent them entirely.

6 Vagot my performed an average of 51 days after Alann Williamson operations in dogs reduced the incidence of peptic ulceration following this operation from a control level of 85 per cent to 11 per cent.

JOSEPH CARTER, M.D.

Symposium on Vagotomy for Peptic Ulcer Early Surgical Results in 43 Cases. THOMAS V. P. JORDAN and WILLIAM E. GROCK. *Bull Johns H ph ns II* p 947 8 9

Vagotomy for peptic ulcer has been performed on 43 patients at the Johns Hopkins Hospital Baltimore Maryland. In this series 4 different operative procedures have been used.

1 Tran thoracic vagot my with division of the greater splanchnic nerve on one side was performed on 3 patients.

2 Vagotomy alone was done in 16 cases (trans-thoracic 11 abdominal 5).

3 Vagot my with gastroenterostomy was done in 8 cases and with Finney pyloroplasty in 2 cases.

4 Vagotomy and gastric resection was done in 14 cases (Polya 7 Hofmeister 7).

The clinical results in 34 (83%) of the 41 patients followed from 10 to 24 months have been satisfactory in the remaining 7 cases (17%) they were unsatisfactory. Excluding the 1 patient who died with complication of craniotomy and 3 patients in whom vagotomy was complicated by simultaneous division of one splanchnic nerve, the corrected results are no mortality in 37 patients satisfactory results in 33 or 89 per cent and unsatisfactory results in 4 or 11 per cent. The 2 patients not followed up were doing well at the time of discharge.

In the satisfactory results, the cessation of ulcer pain has been most striking and has overshadowed other troublesome, although transient, effects of vagotomy. These, in order of frequency have been (1) an increase in the number of daily stool with occasional diarrhea, (2) postprandial fullness, and (3) occasional postoperative vomiting, the latter two effects being related to the motor paralysis of the stomach which followed vagotomy in 24 patients.

Of the patients with unsatisfactory results 3 have come to reoperation 1 for recurrence of ulceration and 1 for intractable gastric retention and dilatation due to vagot my motor paralysis. There are 3 patients in this group who have continued to show uncontrollable signs of severe gastroparesis and may need gastroenterostomy in the future.

All of the failures occurred in the patients who had vagotomy without any additional operative procedure either plastic or ablative on the stomach itself. The results have been uniformly satisfactory in the 24 patients undergoing some such procedure in addition to vagotomy. The most satisfactory results 11 occurred in the 10 patients in group 3 who had gastroenterostomy or pyloroplasty along with the vagotomy.

JOSEPH CARTER, M.D.

Symposium on Vagotomy for Peptic Ulcer Medical Aspects of Vagotomy for Peptic Ulcer including Observations on the Clinical Value of the Insulin Test and on Postoperative Criteria for the Completeness of Bilateral Gastric Vagus Section. MORRIS PAULSON and EUGENE S. GARDNER. *B H Joh H ph ns II* p 947 8 107.

The authors analyze the same 4 groups of patients as in their previous article omitting the group in which vagotomy with splanchnicectomy was done.

The most striking result was complete cessation of pain. The complete relief of pain after vagotomy is not an unmitigated blessing. Recurrent ulceration, perforation, and obstruction may be difficult to recognize. All the patients undergoing vagotomy alone complained of varying degrees of failure. Diarrhea was brief and readily controlled.

X rays showed gastric dilatation and atonic and peristaltic diminution. By the end of the first postoperative year most of the stomachs showed normal tonicity.

Gastroscopy showed a patulous antrum and lessened peristaltic activity after vagotomy. After subtotal gastrectomy and vagotomy gastroscopy frequently showed edema erosion hypertrophy and friability in the residual gastric pouch and the attached jejunum.

JOSEPH CARTER, M.D.

Surgical Ascariasis (Ascariidosis chirurgica). D. FEN and O. JELKOWSKI. *Arch Ital mal pp diger* 941: 13 390.

The author reports 5 cases of ascariasis, as follows:

1 Perforation of the small bowel. A female worm and purulent fluid were found at operation. The perforation about 5 mm. in diameter, was closed and the abdominal wound drained. The patient died after a period of 36 hours. A partial autopsy was performed and the perforation was found to be adequately closed. Diffuse purulent peritonitis was present, and 14 other worms were found in the intestinal lumen. The literature is reviewed and ample confirmation is cited to show that ascariasis infection can be followed by perforation due to traumatic activity caused by the parasite.

2 Postoperative duodenal fistula following a gastric resection (Polya Reichel). The patient discharged dead female worm on the eighth day, when the wound was incised because of infection. On the twelfth postoperative day 3 living worms were found beneath the dressing. The condition rapidly became worse and antihelminthic therapy was started, with prompt response and improvement. The patient vomited 20 worms, 7 were expelled through the duodenal fistula, and 13 in the stools.

3 Chronic appendicitis with female ascariasis in the lumen of an appendix about 8 cm. in length and of the calibre of a pencil.

4 and 5. Intestinal obstruction. Operation performed in both cases and the small bowel was opened for removal of the parasites. The first patient age 6 was taken home after the second day in

a critical condition and no further notation was made. The second patient age 11 was operated upon in 1941 with an uneventful recovery. She was again operated on in 1943 for the same condition which was complicated by wound infection and fecal fistula and the patient died after 1 month's hospitalization.

An interesting review of the literature with special emphasis on pathogenesis is presented. Perforation of the bowel is ascribed to traumatic activity while obstruction is caused by grouping of the worms thus forming a mechanical block. Small doses of anthelmintics may be a factor in merely stimulating the worms to move and thereby causing a mass large enough to obstruct.

LUCIAN J. FROEDT, M.D.

Benign Intestinal Tumors of Vascular Origin
JOSEPH A. LAZARUS and MORRIS S. MARKS. *Sur gery* 1947 22 766

A total of 38 cases has been reported including 9 of the authors. The age incidence of the patients varied from 2 months to 81 years. Twenty three of the tumors occurred in men and 15 in women. Bleeding was the most constant symptom (in 69.2%) and intestinal obstruction was noted 5 times. Fourteen of the lesions were located in the small intestine, the others were scattered throughout the bowels. Fifteen of the tumors were found only at necropsy and were without clinical symptoms.

The lesions found were nevi (6), angiomas (11), cavernous angiomas (11) and capillary hemangiomas (5).

The tumors may occur singly or multiply.

FRANK B. QUINN, M.D.

Solitary Neurofibroma of the Small Intestine. WERNER MÖLLER. *Acta chir scand* 1947 96 1

The author describes the case history of a 40 year old man with a neurofibroma the size of a human head which was removed from the small intestine. The localization, anatomic peculiarities and symptomatology of intestinal neurofibromas are discussed. From a surgical standpoint these lesions probably should be considered potentially malignant and should be treated by intestinal resection rather than by simple removal.

EDWARD W. CRESS, M.D.

Talcum Powder Granuloma: A Frequent and Serious Postoperative Complication. BEN EISENMAN, M. G. SKELLO and NATHAN WOMACK. *Ann Surg* 1947 126 820

The authors present 37 cases of postoperative complications due to talcum powder granuloma. These cases represent a wide diversity of complications ranging from simple wound abscesses to serious sequelae such as fecal fistulas and intestinal obstruction. The clinical and pathologic nature of this condition is discussed. Emphasis has been placed upon the requirements of a suitable alternative dusting powder for use in the operating room. The best answer to the problem is believed to be the

use of wet gloves or the substitution of an innocuous dusting powder. Potassium bitartrate, properly sterilized, can be used. Talcum powder must be banned from the field of surgery.

The authors review their experimental and clinical work with formalized starch compounds. The starch compounds as now produced are not completely stable, and must be further modified before their use can be recommended.

CHARLES BARON, M.D.

Megaduodenum: A Clinical Study (Sul megaduodeno studio clinico) ATTILIO BASILE. *Ann ital chir* 1947 24 233

The case report of a 42 year old patient with megaduodenum is presented. Symptoms began at 12 years of age. About 10 years ago a gastrojejunostomy was performed. This was followed by relief for a period of 1 year after which the symptoms returned; these became worse following a second operation which consisted only of a viscerolysis and the patient had to resort to the frequent use of opiates. The symptoms consisted of pain after meals vomiting after meals and with a fasting stomach, anasthesia and loss of weight.

X ray studies revealed a functioning gastroenterostomy, high lying, which did not empty the entire stomach. The opaque meal which passed through the stoma was readily carried on through, but that which passed through the pylorus showed a marked distention of the horizontal portion of the duodenum.

The patient was subjected to a third operation in which the adhesions were separated, the gastrojejunostomy was taken down, the jejunum was resected in the region of the stoma with end-to-end anastomosis and a Polya type gastric resection and duodenojejunostomy by the method of Braun were carried out. The patient made a good recovery with no recurrence of symptoms even after returning to strenuous work.

In discussing the symptoms, the author states that the clinical diagnosis is difficult. The two differentiating points are (1) onset of gastric disturbance in early childhood and (2) retention vomiting with bile in contradistinction to retention vomiting of pyloric stenosis which does not contain bile. The x ray studies usually lead to the diagnosis.

As to therapy Basile states that some authors recommend medical management. However he believes that the treatment is exclusively surgical and that medical management usually results in a far advanced condition and a poor risk patient. It is much better to operate before this state ensues.

LUCIAN J. FROEDT, M.D.

Subcutaneous Retroperitoneal Duodenal Rupture. GUNNAR K. LAURITZEN. *Acta chir scand* 1947 96 97

Subcutaneous retroperitoneal duodenal rupture is a rare lesion with a bad prognosis. However the author reports a personal case with favorable outcome treated by bowel suture and drainage as well as extraperitonealization by suture of the anterior

to the posterior peritoneum. This method was employed even previously also with recovery. The present case is the third recovery reported in Sweden.

Because of the rare occurrence of this trauma there is no course which may be considered typical, practically every case having its distinct problems. The etiology is occupationally determined but tends in our day to be due to motoring. Recently due to the war explosions in the water have been reported to result in well defined ruptures which are easily amenable to suture. Subcutaneous retroperitoneal duodenal rupture is localized to the second and third portion of the duodenum in 50 per cent of the cases.

The diagnosis is difficult because of the absence of the symptoms of peritonitis usually so alarming in intestinal rupture. X-ray examination rarely gives information by revealing a retroperitoneal emphysema. Without operation the course is nearly always fatal. The indications for explorative laparotomy are augmented by the fact that early operation decides the prognosis. It is generally easy to detect the presence of a serious internal lesion.

At operation a retroperitoneal edema usually translucent and suggesting underlying blood or bile, and a palpable or visible emphysema suggest duodenal trauma. The recognition of this is important, as in approximately every fourth case the picture has been interpreted as a contusion and the lesion has not been detected. Coincident lesions must not distract due attention. A most careful exploration of the entire duodenum must be done as several ruptures may occur simultaneously or a nonperforating lesion of the wall or a loosening of the bowel may be present and present the risk of a secondary perforation.

It appears that simple suture has been done most frequently. Each case however must be treated individually also in regard to palliative or prophylactic measures. The least intervention possible should be the aim. Drainage is advisable also in conditions favorable to suture.

The prognosis is precarious. The total material shows recovery in about 32 per cent of the cases. For the last 35 years recovery has taken place in about 50 per cent of the cases. However these figures may be unduly favorable as cases with a lethal course may not have come to publication.

H. J. & GOLDMAN, MD

Acute Diverticulitis of the Cecum. L. ANDERSSON
Surgery 947 479

Although diverticula of the cecum are considered rather rare the author was able to find records of 99 cases in which operation had been performed because of acute diverticulitis of the cecum. The average age incidence of the patients was less than 40 years, which is much lower than that for diverticulitis in the remainder of the colon. The cases were about equally distributed between the two sexes which is also different from the findings in most studies on surgical diverticulitis, which show a preponderance of males. More than a third of the surgeons performed extensive operations such as resection of the

cecum or right colectomy. This is understandable in view of the difficulty of distinguishing a perforated and inflamed diverticulum from carcinoma at operation. Eighty-four per cent of the surgeons listing a preoperative diagnosis thought the appendix to be the cause of the patient's symptoms previous to operation.

We believe that acute diverticulitis of the cecum is a surgical disease and will continue to be so for a long time to come, since it seems very difficult to distinguish from appendicitis preoperatively and since roentgenologic studies of the colon following barium enemas are usually contraindicated when the most probable diagnosis in a case is appendicitis.

A Consideration of Pathological Factors Influencing 5 Year Survival in Radical Resection of the Large Bowel and Rectum for Carcinoma. R. K. GILBERT and VERNON C. DAVID. (Am Surg 1947) 26 4

The authors' study is an extension of their previous work. It is based on the clearing of specimens, and the meticulous dissection of lymph glands which are charted as to their anatomical location and studied microscopically to determine the presence of tumor cells. The thoroughness of their work is indicated by the large number of glands found in each patient (an average number of 55 per patient) as compared to the number of glands found in a routine pathological examination.

Two hundred cases were studied. The operability rate was 75 per cent and palliative resections are not included in the statistics.

The tumors were grouped anatomically into four divisions. One group included patients with lesions of the right half of the colon and the first 3 inches of the transverse colon. A second group included tumors of the left half of the colon, the remaining transverse colon and the descending colon to the redundant loop of the sigmoid. The third group comprised tumors of the redundant sigmoid down to and including the pelvic peritoneal floor which lesions were entirely covered anteriorly by peritoneum. The fourth group was made up of all other lesions grouped together as extraperitoneal rectal tumors.

Fifteen patients had tumors of the right half of the colon, 13 had nodal involvement and of these, 7 (53.8%) were alive 5 years or more following resection. The 2 patients without nodal involvement were alive 5 years after resection.

Of 18 patients with tumors of the left half of the colon, 8 had nodal involvement and of these 3 (37.5%) were alive after a period of 5 years of the 10 patients without nodal involvement, 8 (80%) were alive after 5 years. Although only 44 per cent of the tumors in this region had nodal involvement—a lower percentage than that in the other regions—death from recurrence was relatively higher which would suggest that resections in this area generally are not wide enough.

Of 55 patients with tumors in the redundant sigmoid 35 had involvement of the nodes and 9 (51.4%)

of these were alive after a period of 5 years 20 patients were found to have no nodal involvement and 18 of these (90%) were alive after a period of 5 years.

There were 112 patients with carcinoma of the extraperitoneal rectum 69 of whom had nodal involvement and of these 26 (37.5%) were alive after 5 years. Of the 43 without nodal involvement 32 (74.4%) were alive after 5 years. Local recurrence was great in this group.

Fifty seven per cent of all of the patients in this series were alive 5 years or more after resection 78.5 per cent of the total number of patients without nodal involvement were living from 5 to 10 years after surgery.

Three women were pregnant when the diagnosis of tumor was established and 2 of these were living after a period of 5 years.

Forty per cent of the patients requiring resection of adjacent structures because of their adherence to the cancerous portion of the colon survived for a period of 5 years or more. This figure could be improved by chemotherapy and supports the trend to radical resection in such cases.

The dissections revealed several other important findings. Retrograde metastases 1 to 5 cm below the tumor occurred in 7 of the 153 tumors below the promontory of the sacrum. In 8 of the patients who died following surgery all of the retroperitoneal tissues from the celiac axis to the base of the bladder were cleared and studied. Two patients who were without nodal involvement at surgery were found to be free of involved nodes in the postmortem specimen 4 patients who had nodal involvement at surgery had further involvement in the cleared specimen and of these 3 would have been cleared of involved nodes if the operative dissection had been 1.5 cm wider.

FREDERICK C HORNER, M.D.

A Suspension Operation for Prolapse of the Rectum THOMAS G ORR, *Ann Surg* 1947 126 833

A suspension operation for complete prolapse of the rectum is described. Two strips of fascia from 1 to 2 cm wide and from 10 to 12 cm long are excised from the fascia lata. A left paramedian incision is made from the pubis to a point about 2 cm above the umbilicus. The patient is placed in the Trendelenburg position and the abdominal contents are packed away from the pelvis with warm moist pads. A tape is passed through the mesentery beneath the lower

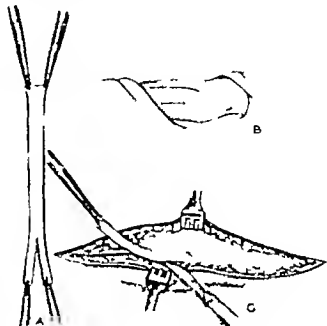


Fig. 1 (Orr) A, B, C Technique of removal of fascial strips from fascia lata.

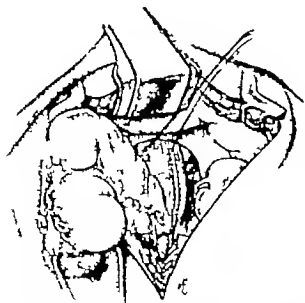


Fig. 2 (Orr) Fascial strips sutured to rectal wall and to fascia above the promontory of the sacrum. On the left the fascial strip is passed through the mesentery of the sigmoid.



Fig. 3. A fold of peritoneum has been sutured to the rectal wall on each side to cover the fascial strips. The cul-de-sac has been obliterated by rows of sutures placed transversely across the pelvis.

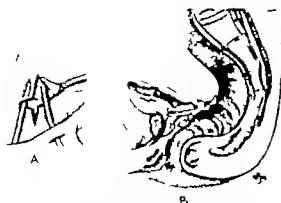


Fig. 4 (Orr) A Detail of attachment of fascial strips to fascia above the promontory of the sacrum. B Lateral view of pelvis showing closure of cul-de-sac and location of fascial strip on wall of rectum. (Courtesy of J. B. Lippincott Co.)

sigmoid for traction. Gentle traction will hold the prolapsed rectosigmoid in normal position. The fascia just above the promontory of the sacrum is exposed through an inverted T-shaped incision in the peritoneum. A strip of fascia is sutured to each side of the rectum with a double row of interrupted sutures of fine silk. The strip of fascia on the left is passed through a puncture wound made in the mesentery of the sigmoid. While the rectum is held suspended, the upper ends of the fascial strips are sutured to the dense fascia above the promontory of the sacrum. Interrupted silk sutures are used to attach both margins of the fascial strips to the fascia, a distance of at least 1 cm. The cul-de-sac is completely obliterated by two or more rows of interrupted silk sutures placed across the pelvis. The peritoneum is sutured to the anterior wall of the rectum as each row of sutures is placed. The pelvic operation is completed by suturing a fold of peritoneum to the rectum on each side to cover the fascial strips. The abdominal and thigh wounds are closed with silk.

The results in the 4 cases have been satisfactory. There has been no evidence of recurrence of the prolapse, and the function of the rectum has been normal. The possibility of constriction or angulation of the lower sigmoid at the sacral promontory was considered but this has not happened. A barium enema showed a normal caliber of the rectosigmoid in 3 cases.

CHARLES R. ROY, M.D.

Considerations of Proliferative and Stenosing Proctitis (Considérations sur les rectites proliférantes et sténosantes) MARIN PORCECO-URIBE and C. AZCUTTE. *J. chir. P.* 1947 63: 365.

This disease which appears to be a definite clinical entity remains a complex problem. There are factors which suggest a lymphogranulomatous origin but the virus found at the border of the rectal lesions cannot be cultivated and reinoculated

to produce the disease. Other factors suggest that the lesion may not be of lymphogranulomatous origin.

The authors have reviewed 31 cases and believe that there is a direct connection between the virus of Nicolas and Favre and Ducrey's bacillus in the production of proliferative and stenosing proctitis. The organisms may be inoculated by the rectal or vaginal route but the lesions always begin at the border of the rectal mucosa and spread distally and proximally. The associated periproctitis is not a cause but a result of the rectal lesions.

EDWARD W. GIBBS, M.D.

Surgical Treatment of Proliferative and Stenosing Proctitis. Operative Technique (Le traitement chirurgical dans les rectites proliférantes et sténosantes. Technique opératoire) MARIN PORCECO-URIBE and C. AZCUTTE. *J. chir. Par.* 1947 63: 379.

The authors recommend surgical treatment as the treatment of choice for proliferative and stenosing proctitis. The most ideal operation would seem to be a rectocolic resection by the abdomino-endo-anal route with re-establishment of bowel continuity.

This procedure allows one to get beyond the limits of the disease, preserves as much intestinal motility as possible for subsequent anastomosis, permits a smaller amount of endo-anal dissection, and avoids operation through areas of fistulous tracts and elephantiasis.

The preoperative care, selection of anesthesia, operative technique, and postoperative care are discussed. Accidents and postoperative complications are enumerated.

EDWARD W. GIBBS, M.D.

Carcinoma of the Rectum JOHN TURNER. *Austral. N. Zealand J. Surg.* 1947 17: 5.

An analysis of the records of carcinoma of the rectum in three teaching hospitals in Melbourne is presented—190 cases in 10 years.

Means whereby the operability rate could be increased and the mortality rate decreased are suggested.

1. The adoption of the combined type of operation (abdominoperineal or perineoabdominal) as a standard method of approach. It is considered that this method allows more patients to be included in the operable group.

2. A more liberal view of the assessment of operability. As in any form of malignant disease, the operability depends upon (a) the presence or absence of metastases (b) the fixity of the tumor and (c) the general condition of the patient.

a. The presence of metastases (after clinical examination or abdominal exploration). Cases falling into this category need no comment and do not affect this discussion.

b. Fixation of the growth. Local records show that fixation of the growth is the most common contraindication to resection. A bolder approach to this problem seems warranted. It is frequently found that a growth apparently fixed in one or another

direction is readily removable. This is particularly the case when the growth is fixed posteriorly or when it is adherent to the vaginal wall. The estimation of what can be adequately removed is obviously a matter of considerable experience and judgment. Rectal examination is the deciding factor in growths situated in the lower and middle thirds and in a few cases with intussusception in the upper third. Placing the patient in the right lateral position and examination with the left index finger, as suggested by Miles, are of the greatest assistance in a difficult case. When the growth cannot be examined completely in this manner the decision as to mobility must be delayed until laparotomy is performed.

c. The general condition of the patient. The majority of younger people suffering from the disease are in satisfactory condition or can readily be brought into a satisfactory condition by suitable preoperative treatment. The most common consideration is old age and its associated cardiovascular and renal disease and these are frequently cited in case histories as a contraindication to removal, particularly when resection appears difficult on clinical examination. However with well planned preoperative and postoperative management it is surprising how well such patients stand radical operative procedures. Old age, arteriosclerosis and renal insufficiency should be treated on their merits and if they are not likely to cause the early demise of the patient *per se*, resection should be performed if the condition is otherwise operable.

The use of colostomy in cases regarded as inoperable is discussed.

Combined perineoabdominal excision without preliminary colostomy is recommended as the method of choice in the majority of cases.

The importance of the preoperative and postoperative treatment is stressed and described as used.

The postoperative complications are discussed, with particular reference to bladder dysfunction and to complications arising from the colostomy.

The care of the colostomy is described in detail.
JOHN J. MALONEY, M.D.

Anorectal Malignant Melanomas. OTTE MULLER.
Acta chir. scand., 1947 90: 39.

Malignant melanomas seldom occur in the gastrointestinal tract, but when they are found there they are mostly in the region of the anus. About 80 cases of melanoma situated in the rectum have been reported in the literature. These constitute from 2 to 3 per cent of all malignant melanomas.

The mean age of the patients is about 50 years and the ratio of men to women is 18 to 10. While the melanoma varies widely both as to quantity and mode of appearance there is more pigmentation in the tumors situated nearest the anus. Melanoblasts are derived from the ectoderm which is the probable origin of melanomas.

The clinical picture is partially characteristic since melanomas are solid with no tendency toward circular growth but with considerable infiltration

in the rectal wall. Ulcerations are superficial there is no necrosis or crater formation. The infiltrative characteristics make radical surgery necessary with removal of the regional lymph nodes—in this case the retrorectal nodes. The necessity for careful dissection of lymph nodes even if they show no clinical signs of tumor is stressed.

Malignant melanomas possess a pronounced tendency to metastasize. Approximately 87 per cent metastasize to the liver and 50 per cent to the lungs and pleura. The retrorectal nodes are involved much more frequently than the inguinal nodes.

Radiosensitivity is generally slight although exceptions have been reported.

The mortality is about 78 per cent with a 5 year cure rate of not more than 13 per cent.

FRANK B. QUINN, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

On the Surgical Aspect of Acute Hepatitis. ERNST BERGMAN.
Acta chir. scand., 1947 96: 17.

The author contends that acute hepatitis, while primarily a medical disease often becomes complicated by accumulations of mucus which produce obstruction in the lower part of the common bile duct. This obstruction is sufficient to stop the flow of bile which is under subnormal pressure as a result of the hepatitis.

Surgical intervention was carried out in 7 cases of this type in which the jaundice was not relieved by medical therapy. The biliary passages were perfused with cholangiographic contrast matter and in some instances, normal saline solution was added. Following the operation the jaundice disappeared rapidly and the patients recovered.

EDWARD W. GIBBS, M.D.

Hepatic Calculi. ANTHONY BARKER and A. GERRARD.
Peters. Am. J. Med. Sc. 1947 314: 433.

Hepatic calculi have been found in as high as 7.6 per cent of some series of cases of cholelithiasis. The immediate mechanism causing the formation of the stones is probably chemical. They present no characteristic symptomatology and the symptoms if present, are usually due to the coexisting cholelithiasis. The clinical diagnosis is made only by means of roentgenography and the other causes of calcification must be ruled out (hemangiomas, amebic abscess, echinococcus cyst, gummas, tuberculomas, carcinomas). If the hepatic calculi are causing no symptoms conservative treatment is indicated. Operative treatment depends in great degree on the associated findings, such as gallstones or common duct stones. In the presence of liver stones the mortality rate in operations on the biliary tract is greatly increased.

True uncomplicated hepatic calculi appear to be compatible with long life and comparative good health and thus the treatment should be conservative. In the presence of complications, such as

liver abscess, cholelithiasis, cholangitis, and common duct obstruction the treatment should be directed to eradicate the complication.

F. J. LAMARCA, JR., M.D.

The Innervation at the Junction of the Common Bile Duct and the Duodenum from a Surgical Point of View CURT FRANKSON *Acta chir scand.* 947 96 63.

The author made a detailed study of the innervation at the junction of the common bile duct and the duodenum with the object of providing an anatomical basis for surgical operations in this region.

The study was made on postmortem cases that did not show morbid changes within the area examined. The course of the nerves was studied macroscopically and microscopically.

The celiac plexus is regarded as a unit having several communications with the sympathetic trunk.

The duodenal papilla (Vater) is innervated mainly by the common bile duct nerves, which run from the dorsal hepatic plexus along the common duct. Fine nerve communications, pancreatic nerves, have however been found along the pancreatic duct.

The nerves to the upper part of the duodenum and pylorus are described.

The possibilities of denervating the duodenal papilla (Vater) are discussed and a suitable technique for the purpose is described.

The nerve plexus on the anterior aspect of the aorta, the bulk of which is situated just below the diaphragm, provides a large part of the abdominal viscera with autonomous innervation. It is termed the celiac plexus and is sometimes described as being divided into two branches, one on the right and one on the left side of the aorta. This division, however, is anatomically vague and is scarcely justifiable from a surgical point of view.

The celiac plexus is provided with sympathetic nerve fibers which pass mainly through the three splanchnic nerves. By the close relation to the abdominal aortic plexus, however, ample provision is made also for other communications with the sympathetic trunk.

Parasympathetic nerve fibers are distributed to the celiac plexus from the posterior vagus trunk, according to McCrea, through a large nerve trunk issuing just below the diaphragm and following the posterior abdominal wall. The anterior vagus trunk, according to McCrea, is in communication with the celiac plexus by nerve fibers running across the uppermost part of the stomach and then following the left gastric artery.

From the part of the celiac plexus lying between the aorta and inferior vena cava a group of nerve fibers proceeds toward the right. These fibers are usually divided into three main trunks. This group is termed by several authors (Latarjet and Alexander) as the plexus hepaticus posterior (dorsalis). These nerves pass dorsal to the portal vein. They reach the caudal part of the epiploic foramen (Winslow) and run there in a ventral direction.

The largest branches join the cystic and hepatic ducts reaching the gall bladder and liver, respectively. Two or three finer branches about a millimeter in thickness, branch off in a duodenal direction and join the common bile duct. They also send some fibers to the pancreas which, in addition, receive nerves from the celiac plexus along its vessels.

The nerves that join the common bile duct approach the latter from the dorsal side, giving off small branches to the duct which gradually merge completely with its wall. Sometimes one finds a nerve branch running through the pancreatic head and reaching the common bile duct near the duodenum. Macroscopically the nerves can be followed to about 1.5 cm. from the place where the common bile duct pierces the duodenal wall, and by means of a microscope, they can be followed 1 or 2 cm. further. They are finally merged completely in the common bile duct wall. The nerve fibers have been followed further toward the tip of the duodenal papilla with the aid of a microscope and serial sections. In the sections the nerves become finer as they approach the tip of the papilla. Here and there ganglion cells adjoin them. The entire papillary area has been sectioned and nerves, although very fine, were found right out to its extremity. They are distributed in all layers of the wall.

Under the microscope it can also be observed that a few fine nerves, after passing along the pancreatic duct, reach the papillary area. Through these nerve fibers and the pancreatic nerves, there is a closer communication between the papillary area and the celiac plexus.

No direct communications with the nervous apparatus of the duodenal wall have been observed, although with the histological methods adopted here, very fine communications of this nature cannot be completely ruled out. The well delimited nervous apparatus which was detected indicates, however, that such communications with the duodenum are scarcely of any great importance.

A division into different nerve plexuses within the common bile duct wall (adventitial, intramuscular, submucous) as reported by Alexander has not been observed.

From the celiac plexus and around the celiac and hepatic arteries there is another nerve plexus, (plexus hepaticus anterior ventralis) according to Alexander and others, which sends three or four nerve branches toward the dorsal side of the duodenum at the triangle formed by the right gastric artery, the common bile duct, and the duodenum. These nerves anastomose with the direct vagus branch to the porta hepatis. The duodenum is also supplied with nerves from the celiac plexus which run along the blood vessels, the pancreaticoduodenal artery and the right gastroepiploic artery.

About 1 cm. below the diaphragm, the left vagus nerve (the anterior vagus trunk, according to McCrea) gives off a branch which passes toward the porta hepatis through the lesser omentum. A minor part of this branch bends off toward the pyloric area,

where it branches out to supply the uppermost part of the duodenum, the pylorus and the adjacent part of the prepyloric area. The nerve fibers to this region can be followed for about 3 cm. toward the cardia where they meet the nerves coming from the upper end of the stomach. No actual communication between them has been observed but they overlap in distribution.

Near the junction of the cystic and hepatic ducts there are some fine anastomoses between the nerves of the common bile duct and the nerve fibers winding around the hepatic artery. (They correspond to Alexander's anastomoses between the anterior and posterior hepatic plexus.)

To regard the celiac plexus as being divided into a right and a left part is scarcely warranted from a surgical point of view. It would be more correct to regard the celiac plexus as a unit.

Besides the splanchnic nerves, the celiac plexus has several communications with the sympathetic trunk through the abdominal aortic plexus.

"*Nervi choledochi et pancreatici*" is the term used by Swan Latarget *et al.* Raigorodsky, Alexander Reich and Perman to describe a nerve which runs along the dorsal side of the common bile duct. The description ends with the nerve at the duodenal wall.

No statements have been found regarding nerve communications along the pancreatic duct.

The present investigation has shown that there are several nerve trunks passing along the common bile duct in the duodenal direction (*nervi choledochi*) and that more than one of them reach the nerve mechanism of the duodenal papilla. A nerve communication from the papillary region along the pancreatic duct (*nervi pancreatici*) and the pancreas to the celiac plexus has, moreover, been observed.

Alexander's division of the nerves of the common bile duct wall into different plexuses (submucous, intramuscular, adventitial) has not been verified. For this purpose however a different histological technique is presumably required.

The results of this investigation of the duodenal nerves correspond in essentials with the findings of Swan Latarget *et al.* Raigorodsky and Perman, i.e. nerve trunks arise from the celiac plexus and pass from there along the common bile duct to the duodenum.

McCrea and Perman describe the pyloric nerve as innervating the uppermost part of the duodenum and pylorus. Similar conditions have been shown by this investigation. The finer nerve fibers were followed in the prepyloric area right up to the place where (about 3 cm. from the pylorus) they meet the nerves coming from the upper end of the stomach.

The same anastomoses as those described by Alexander at the junction of the cystic and hepatic ducts have been found.

From a surgical point of view the pyloric nerve and the nerves of the common bile duct (*nervi choledochi*) are of special interest.

The prepyloric area (*canalis ventriculi*) is known to have a powerful motor apparatus and is considered

to play an important part in the emptying of the stomach. Its acid production on the other hand is of minor importance.

The impulses through the pyloric nerve are consequently important for the emptying of the stomach whereas they are believed to have less effect on the production of acid.

A thoracic vagotomy completely cuts off the vagus supply to the stomach. In the case of an abdominal vagotomy the vagus branch to the porta hepatis and thus also the pyloric nerve can be preserved. In the latter case the acid production of the stomach may perhaps be reduced but the motility in the prepyloric area which is essential for the emptying of the stomach will be retained.

If section of the pyloric nerve is desired it is quite accessible just outside the pylorus as pointed out by Latarget and McCrea. The origin of the pyloric nerve, the direct vagus branch to the porta hepatis is in fact easily accessible in the lesser omentum a few centimeters below the diaphragm. It is almost always seen in abdominal vagus resections.

The papillary region of the common bile duct is innervated in two different ways—by the pancreatic nerves and by the common bile duct nerves.

The communication with the pancreas is extremely slender and under normal conditions seems to be of little importance. If however the other nerve communications to the papillary region are destroyed it is conceivable that the communication with the pancreas might assume greater importance. To attack it surgically seems nevertheless to be out of the question at present.

The nerves of the common bile duct are certainly the normal channel for the transmission of impulses to the papillary region. As has been described they are rather scattered at the periphery and are most closely concentrated after they have passed the portal vein at the caudal part of the epiploic foramen.

Reich (1940) and Perman (1944) have described a technique for denervation of the papillary region of the common bile duct as a remedy for spasm in the sphincter of Oddi. As the most suitable way of finding "the common bile duct nerve" they suggest that the operator enter from a ventral direction between the portal vein and the common bile duct. Here the main nerve trunks from the celiac plexus are congregated. The smaller branches of the common bile duct nerves may sometimes be quite accessible. However in cases in which there is a branch running rather far dorsally and which perhaps also passes through the pancreatic head it will scarcely be accessible by this method.

For denervation of the duodenal papilla (Vater) it is proposed that the nerves of the common bile duct be exposed and resected at the caudal part of the epiploic foramen.

The duodenum must be mobilized at the part corresponding to the common bile duct area. The common bile duct is retracted to the left and the peritoneum is divided along the caudal part of the epiploic foramen. Any subserous fat is removed. The thick

nerve trunks from the celiac plexus as well as the nerves of the common bile duct are then exposed.

The main branch of the dorsal hepatic plexus, situated nearest the duodenum, is resected as well as all of the common bile duct nerves. The resection is made as close as possible to the celiac plexus and the common bile duct.

This procedure is perhaps more difficult technically than that recommended by Reich and Perman, but, on the other hand, it yields more reliable results.

The technique of denervation of the duodenal papilla is described in the following case report.

The patient was a woman, aged 38, who 4 years previously had undergone cholecystectomy. She had been suffering for 2 years from severe gallstone-like attacks. They recurred about twice a week.

Operation (M-n) Percutaneous narkotic Pribram section. The common bile duct was easily exposed and cholangiography was attempted. Considerable resistance was encountered on the injection of the dye which ran out into the duodenum in a narrow stream. Flexible bougies Nos. 14 to 16 were passed without any noteworthy obstruction. The pressure in the common bile duct varied directly with the depth of anesthesia. Denervation of the papilla was resolved upon. Mobilization of the duodenum according to the method of Kocher, mobilization of the whole pancreatic head and division of the peritoneum at the caudal part of the epiploic foramen was done. The nerves of the papilla, common bile duct and liver were exposed. All the nerves except the uppermost of the main branch were resected. The duodenum was replaced and fixed with serous suture. Cholangiography then showed a normal passage to the duodenum. The patient has been free from pain since the operation which was done 4 months ago.

BL. JAMES GOLDEN, M.D.

A Particular Biologic Action of Blood from Patients with Acute Pancreatitis (Sopra una particolare azione biologica del sangue di pancreatiti acuti) P. AM. 208 OM and G. C. 460 OM. *Poll. I. chir. prat.* 9:47-54, 36.

The present communication has for its subject consideration of a strange case of sterile phagedena following a blood transfusion—a patient with hemorrhagic pancreatitis, and of a particular biologic reaction which can be obtained in small injected with blood of patient with acute pancreatitis.

A 40-year-old married female was treated early in January, 1945 for a blood arthropathy with intravenous choline. On the eighteenth of the month at about eleven o'clock in the morning she had received an injection intravenously. Three hours later after having eaten with a good appetite she felt a disturbance in the lower abdomen, similar to that onset of menstruation. On going to her room she was suddenly seized with violent pains in the epigastric region radiating to the right and then to the left. This was followed by meteorism and rapid pulse. Biliary colic was suspected but the pains did not respond to analgesics and the patient was sent

to the hospital. At this time hemorrhagic areas were observed on the anterior aspect of the thighs; x-ray films were negative for pneumoperitoneum, and the urine showed traces of albumin.

At operation the patient was found to have hemorrhagic pancreatitis and was given 200 cc. of whole blood and on the third day she was given 150 cc. of whole blood. On the eighteenth day she had an attack of pain similar to that experienced at the onset, and on the following day she was given a third transfusion through the right external jugular. Towards the end, the needle became dislodged and some blood infiltrated into the tissues. No transfusion reaction occurred.

The patient had repeated attacks of pain similar to those at the onset of the illness. A scab was noted at the site of the transfusion in the neck. This area became necrotic and in a period of 4 days a spreading ulcer developed which ultimately involved the supraclavicular and infraclavicular spaces.

Bacteriologic examination failed to reveal pathogenic organisms. For 35 days following the transfusion there was no rise in temperature. The patient died on March 13, 1945 following one of the usual crises accompanied by a grave hemorrhage from one of the vessels in the ulcerated area.

Because of the obscure pathogenesis of the ulcer, it occurred to the authors to inject the blood of the patient and also of the donor subcutaneously in laboratory animals. This was followed repeatedly by ulceration at the site of the injection with patient's blood. Areas injected with the donor's blood and also with that of the author did not cause ulceration. Urine injections were negative.

A second case diagnosed clinically as acute pancreatitis in a patient with duodenal ulcer was also tested in the same way. This patient was not operated upon. Diastase studies revealed 6 units per cubic centimeter in blood and 6 units per cubic centimeter in the urine (method of Wohlgemuth). This was followed by similar ulcerations at the site of injection. A year later the studies were repeated while the patient was in a quiescent stage clinically. The same ulcerations were produced with the patient's blood and negative results were obtained with the blood of normal persons.

The authors believe that if these results can be confirmed in other and more numerous cases, they can then be used as diagnostic aids.

LUCIAN J. FROEDER, M.D.

MISCELLANEOUS

Nitrogen and Fluid Balance in the Treatment of Acute Uremia by Peritoneal Lavage: Analysis of Peritoneal Washings for Protein, Nonprotein Nitrogen, and Phosphorus. SAMUEL H. BASKIN, HERBERT R. BROWN, JR., E. HENRY KROTH, J. JACOB HOLLER and Others. *Arch. Int. Med.* 1947, 60: 615.

Peritoneal lavage using the peritoneal surfaces in vividialysis has been performed in a number of cases.

periments during the past few years. The basis for this work is the well established fact that water crystalloids and some colloids including plasma proteins, are readily absorbed by the lining membranes of the serous cavities. It has been demonstrated further that intact erythrocytes labeled with radiodog by way of the lymphatic vessels of the diaphragm and subsequently appear in the peripheral blood.

Lavage of the peritoneum has been performed in man on a few occasions in an attempt to relieve the intoxication of uremia. Although the number of reported survivals is small (2) with a practical procedure for peritoneal irrigation such as that described by Fine and others and a more careful selection of cases, one may anticipate better results. The authors report the treatment of a patient who died but on whom it was possible to obtain considerable data on the nitrogen and fluid balances during a period of continuous peritoneal irrigation for 21 days after the onset of almost complete anuria.

A single white woman 24 years of age became ill on December 16, 1945 with nasopharyngitis caused by beta hemolytic streptococci. Four weeks later swelling of the hands was noted the blood pressure was elevated and protein was discovered in the urine. Her general condition failed to show improvement and she was hospitalized about 10 weeks after the onset of the original illness.

The electrophoretic patterns of the blood plasma and urinary proteins were determined later and were studied in detail.

An attempt was made to control edema by restricting the intake of fluid and salt but this was not successful in the general ward and the patient was transferred to the metabolic unit.

Attempts to provide an adequate caloric and protein intake were frustrated by nausea and vomiting

and it was soon apparent that the patient's general condition was deteriorating. Ammonium chloride was administered at times in the hope of producing diuresis.

She had a subacute glomerulonephritis and became almost completely anuric 2 days before the irrigation was started. Flow of urine was not re-established and the patient died.

Death occurred rather suddenly on the twenty-first day after peritoneal irrigation had been initiated. The exact reason for death is not known. It is suspected that it was due to exhaustion and shock. Autopsy was limited to exploration of the abdominal cavity.

The anatomic diagnosis was as follows: subacute glomerulonephritis, acute generalized fibrinous peritonitis, ulcerations and erosions of the gastric mucosa, fatty liver, edema and congestion of the gastrointestinal tract, edema of the retroperitoneal connective tissue and the mucosa of the urinary bladder and mild dependent edema.

The choice of peritoneal lavage as a therapeutic procedure presents several technical problems as well as ethical issues. It is obviously unjustified if there are sound reasons for the belief that renal function can never be re-established at a level compatible with survival. It adds greatly to the discomfort of the patient and to the mental anguish of the family and friends. It should not be attempted unless the onset of the anuria is acute and the chance of resolution of the lesion in the kidney within 2 or 3 weeks is good. Renal decapsulation and biopsy have been tried and might be of advantage in suitable cases. One might even question whether the procedure increases the chance of survival beyond that of more conventional methods of treatment.

The technical problems presented are those of infection, nutrition, hydration and regulation of the acid base balance.

HARRY W. FINE, M.D.

GYNECOLOGY

UTERUS

Treatment of Uterine Cancer J HEYMAN J Am
M Ass 1947 35 4 2.

According to the Radiumhemmet experience it is possible to improve the radiotherapeutic results in cancer of the corpus as well as in cancer of the cervix.

For the last 5 years about 85 cases of corpus cancer have been referred annually to the Radiumhemmet for radiotherapeutic treatment. About half of these cases are not suitable for surgical treatment either because of the spread of the growth (10 to 15 per cent of the total) or because of old age, adiposity, cardiac conditions, diabetes, and similar complicating diseases (40 to 45 per cent of the total). The

number of clinically operable cases referred to the clinic by the specialists for radiotherapeutic treatment is increasing year by year. It has thus become an important problem at the Radiumhemmet to develop a satisfactory radiotherapeutic technique for the treatment of corpus cancer.

Since 1933 a combined operative and radiotherapeutic treatment is used in which radiotherapy plays the primary and most important part. Surgery is used only in case of failure of the radiotherapy. The radiotherapeutic technique which is now used in all cases of cancer of the corpus is called the packing method. The uterus is packed with a sufficient number of uniform radium containers to completely fill the cavity. The technique was recently described in detail in the *British Journal of Radiology*. The necessary variations in the treatment times in tabular form are published in the *Acta Radiologica*.

During the period from 1914 to 1941 inclusive 842 patients suffering from cancer of the corpus were examined at the Radiumhemmet gynecologic clinic with a view toward treatment. The result estimated after a period of 5 years from the beginning of the treatment showed 44 to be alive without evidence of the disease, an absolute cure rate of 52.5 per cent.

In cancer of the corpus the result obtained with the packing method (plus operation in case of failure) is considerably superior to that obtained by surgical means alone. It seems to compare favorably with the result obtained by primary hysterectomy plus post-operative irradiation, as far as published results justify such a comparison. By primary radiotherapy equal or better results will be obtained with less risk and less inconvenience to the patients. It is obvious that the use of primary surgical intervention in cancer of the corpus will gradually be substituted by primary radiotherapy.

In the last 34 years 6200 patients with cancer of the cervix have been examined at the Radiumhemmet with a view toward treatment. All patients are traced. Precancerous conditions are included.

In 461 cases a period of at least 5 years has elapsed since the beginning of treatment. A con-

siderable improvement of the result is noticeable since 1935. The improvement is not temporary, it has been noticeable for 15 years, and consequently it is permanent. Because of the size of the samples it cannot be due to chance variations; nor can it be explained by variations in the quality of the clinical material, since 1933 there have been no such variations of any significance. Further, it cannot depend on an alteration of the routine method of brachy-radium treatment. At the Radiumhemmet the Stockholm method is still used. It has been modified only slightly since its adoption in 1914. Finally, there is no sufficient difference in the use of additional roentgen ray and telerialium irradiation to explain the improvement. There is only one acceptable interpretation: the improved results are due to superior judgment in handling the individual case, which in turn originates from increased experience.

The original Stockholm method of treatment of cancer of the cervix consists of a coincident intra-uterine and vaginal application of radium salt, screened by a filter equivalent to 3 mm. of lead. The intrauterine applicator usually holds from 50 to 60 mgm. of radium element, its length corresponding to that of the uterine canal. For vaginal application the tubes are placed in cylinders or flat applicators, which vary considerably in size. The applicators chosen in the individual treatment should be sufficiently large to cover the entire surface of the tumor and to distend the vagina laterally. As a rule they contain from 80 to 100 mgm. of radium. Gause packing provides the necessary distance between the vaginal applicators and the rectum and keeps the applicators in position.

Two treatments are given, each lasting for from 20 to 24 hours, with an interval of 3 weeks. In the 2 treatments the total intrauterine dose is between 2,400 and 2,600 mgm. hours and the total vaginal dose 4,000 mgm. hours. Supplementary roentgen radiation to the parametrium is used as a routine measure. Its value is difficult to estimate even in advanced cases. Variations in the standard technique have been adopted in recent years. The variations are mainly characterized by a 25 per cent increase of the intrauterine dose and a 10 per cent decrease of the vaginal dose. Correct use of the Stockholm method requires considerable variation in the individual case. The vaginal applicators must be chosen with regard to both shape and extent of the growth. Variations in the vaginal dose are necessary with regard to the size and shape of the applicators chosen, the width of the vagina, the age of the patient, and

number of other factors. The treatment is not varied according to the histologic character of the tumors. No practical difference has been observed in the results obtained in the treatment of various histologic types of growth. Because of the numerous variations in the type of case, in the type of treat-

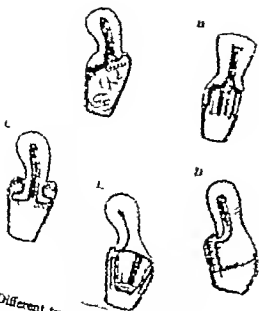


Fig. 1 Different types of intracavitary radium application.

Fig. 2 Microbomb of two different designs for vaginal application.



absolute cure rate. The procedure is justifiable only if the surgical results are superior to those of radiotherapy. It is one of the most important features of radiotherapy that an early cervical cancer need no longer be regarded as a serious disease. From 65 to 80 per cent of the cases which on clinical examination are classified as stage 1 are cured for at least 5 years by radiotherapy. The risk and inconvenience to the patient are considerably less than those caused by surgical intervention. Serious injuries due to radiation are reduced to a minimum and have practically no influence on the estimation of the value of the treatment. In the hands of an expert radiotherapist serious rectal and bladder injuries are extremely rare in the early cases.

CHARLES BARON M.D.

EXTERNAL GENITALIA

Enterocoele or Posterior Vaginal Hernia. JOX VON CORY M.D., Surg. Clin. N. America 1947 37 1236

An enterocoele is a posterior vaginal hernia which consists of a small narrow thin walled sac, probably congenital in origin. It forms behind the cervix and lies between the posterior vaginal wall and the anterior wall of the rectum in the rectovaginal septum. The author states that this hernia is not a prolapse of the posterior cul-de-sac, either primary or secondary to a vaginal subtotal or total hysterectomy. If a deep posterior subtotal or total hysterectomy it should result in a prolapse of the anterior wall of the rectum through the anus. This was demonstrated by Graham in 1942.

Diagnosis is simple and accurate. The patient should be examined in the standing position with the examining finger in the rectum and the thumb in the vagina. The patient is instructed to squat or strain down. This forces air fluid or intestine into the hernia which can now be readily compressed. It will be noted that the lesion is not a rectocele but a bulge in the rectovaginal septum.

The author treats this syndrome by carefully dissecting the hernial sac from the posterior vaginal and rectal walls up to the cervix. The sac is freed and a purse-string suture is placed inside the sac and tied. The author then supplements this procedure with an abdominal operation to examine the suture line and reinforce it.

J ROBERT WILLIOW M.D.

ment, and in the patient's reaction to treatment, each of the varieties constitutes an individual problem. In recent years it has been considered advisable to modify the treatment technique in about 45 per cent of the total number of patients treated.

The identification of the cases in which a modified technique should be employed and a modified administration of the treatment require considerable experience. The technique must be varied from patient to patient and must be carefully planned from the beginning. The effect of the treatment must be closely watched during and after treatment must be time and type of subsequent treatments must be thoroughly considered. For the foregoing reasons the best results cannot be expected unless there are available a sufficient number of beds, an ample supply of suitable radium containers, and a clinic which is well organized for its special purpose. Neither can the best results be expected in places where radiotherapy is handled by a young and inexperienced assistant. In surgical therapy the results are credited to the man behind the knife. It is high time that a similar view be applied to radiotherapy.

In recent years frequent use has been made of electrocauterization in local recurrences not suitable for hysterectomy and in some types of vaginal metastases. This procedure has proved successful in controlling the cancer in a number of cases. It has proved to be a most valuable substitute for hysterectomy in cases in which it is impossible to differentiate between a radium reaction and a local recurrence. The importance of primary surgery in early cases of cervical cancer appears to be considerably overestimated. There is little reason to believe that in a series of selected cases surgical therapy would be superior to radiotherapy. In any event the slight difference between the results in such a small group of cases will never have a significant influence on the

The Occurrence of Enterococci in the Vagina of the Woman (Ueber das Vorkommen von Enterokokken in der Scheide der Frau) HARALD PEREL. *Acta obst. gyna. scand.*, 1947 27 301

The secretions from the upper third of the vagina of 276 women were inoculated in ordinary bouillon which had been enriched with phenol and bile according to the method worked out by K. Schlossmann (N. Schwarz, and K. Schlossmann. *Acta pathol. et microbiol. scand.* 1945, 22 Fasc. 3). A further method of differentiation adopted by the author was based on the resistance of the enterococcus—also known as the streptococcus faecalis—to penicillin: this organism was found to be sufficiently resistant to the drug to be of value as a means of distinguishing the enterococcus from such sensitive bacteria as the *Streptococcus viridans*. In all the strains isolated by the author the beta hemolytic type of growth on blood agar was encountered. In other authors' findings the alpha hemolytic type has predominated. In the infrequent type there is a green ring in the hemolytic area, while in the beta type the hemolytic area is violet, but it may have a slight green sheen particularly if observed at an angle. This discrepancy is believed to be due to the difference in the method of procuring and culturing the material.

The experimental material was divided into a group of 100 women in normal health (the majority of these were pregnant), a group of 108 with a variety of gynecological complaints, such as leucorrhoea, colpitis, adnexitis and Bartholinitis and, finally a group of 68 women in from the third to seventh day of the puerperium. The enterococcus was present in 16 per cent of the first group, in 17 per cent of the second group and in 33 per cent of the third group. An odd fact uncovered during the course of this study was the parallelism between the power of liquefaction of gelatine and that of coagulating milk. In the strains which liquefied gelatine the milk coagulum was of the enzyme type, with a firm contracting clabber and extrusion of the whey, when the gelatine was not liquefied a uniformly distributed coagulation, of the type produced by acids and without the squeezing out of the whey was found to result.

The author believes that the enterococcus may at times play a role in the pathogenesis of gynecologic diseases and that further research is necessary to confirm this. JOHN W. BROWN, M.D.

Primary Carcinoma of the Vagina: A Brief Review of the Literature and Reports of 4 Cases. MURIEL B. McLEATH. *Med J Australia* 1947 3

A review of the present knowledge of the pathology and treatment of primary carcinoma of the vagina is given by the author. All writers agree on the rarity of the condition and on the poor results obtained with the present methods of treatment.

The 4 cases encountered at the Royal Prince Alfred Hospital and at the King George V Memorial Hospital for Mothers and Babies in the period from

1937 to 1947 are reported. These cases agree both in symptoms and in progress with those reported in other clinics. They bear out the description of symptoms and the results of treatment that have been put forward in the literature. However there are several interesting features.

In cases 1 and 3 hysterectomy had been performed 10 and 11 years earlier respectively. All patients had had large families, and in all there was some degree of prolapse or of gaping of the introitus. The patient in case 4 had complete proctostoma. Her case was interesting in view of the fact that although she had a large growth and had removed and resorted the pessary every 24 hours, symptoms had been present for only 3 weeks. Except in case 1 in which the patient complained of vaginal hemorrhage and discharge of 4 years' duration, the history was of short duration. Radiation treatment was the only type used, probably because the patients were elderly and in poor physical condition and radical surgery was impossible. In case 3 evidence of recurrence was shown 3½ years after treatment. All the other patients are dead. In case 1 recurrence took place in 6 months in case 2 in 7 months, and in case 4, in 4 months. CHARLES BARNY, M.D.

Sarcoma Botryoides Vaginae. Complete Excision of the Tumor in an Infant by the Combined Abdominal and Perineal Approach. HOWARD C. FLETCHER and STUART H. QUAM. *Surf. Clin. N. America*, 1947 7 240.

The authors state that this lesion is rare, the rate of its occurrence being one in every 4,000 gynecological admissions. Despite early diagnosis, the prognosis is very poor. This is especially true of the botryoid tumor of infancy and early childhood.

McFarland in 1935 reported 164 cases of vaginal sarcomas, of which 74 were botryoides. All of the patients were under 22 years of age and 41 were children of 2 years or younger. Treatment consisted of surgical excision or radiation, or both. No authentic cures were reported.

These tumors arise beneath the vaginal epithelium and form proliferative, moist, friable growths which project into the vaginal lumen and present at the vulva. In 50 per cent of the cases they begin on the anterior vaginal wall.

The course is one of rapid extension beneath the mucous membrane with invasion of adjacent viscera, especially the bladder. Distant metastases are rare. Sepsis and urinary obstruction are the usual complications.

With the experience gained from the treatment of carcinoma of the cervix with radical surgery plus the utilization of the advancements made in anesthesiology, parenteral therapy and biotherapy it is now possible to remove the uterus and upper vaginal vault without harming the adjacent vital structures. It is also anatomically possible to remove safely the lower portion of the vagina by way of the perineum. With this in mind the authors suggest that sarcoma botryoides vaginae be treated by

complete removal of the vagina, with the use of a combined abdominal and perineal approach.

One case of sarcoma botryoides vaginae in a 26 months old female is reported. The child was treated by complete removal of the vagina, using the abdominoperineal approach. The operation was performed by Mjels. J ROBERT WILSON M.D.

Leucoplakia of the Vulva NORMAN F MILLER, MAY H. PARROTT, JOAN STRYKER, GARDNER M. RILEY and ARTHUR C. CURTIS. *Am J Obst* 1947 54 543.

The authors' interest in leucoplakia stems from two sources: first, an increasing awareness of the numerous shortcomings in the concept of the disease and its treatment and second leucoplakia appears to have considerable cancer potentiality and for this reason should serve as a fruitful field for the study of early development rate of growth and similar aspects of squamous cell carcinoma.

Since July 1931 153 patients with leucoplakia of the vulva have been processed through the University of Michigan Hospital Ann Arbor. Of these 143 were seen prior to July 1945 and were treated in the customary manner with everything from soothing lotions to surgery. These are called a prestudy group in contradistinction to a study group of 36 patients (11 new and 25 return cases) subjected to careful scrutiny and observation since January 1 1946. Such data as were obtained form the basis for this preliminary report.

Since the average age of women with leucoplakia of the vulva is 55 years it is not surprising that a reasonable number should present other evidence of organic disease. The authors were not impressed by any apparent relationship to the vulvar lesion in those patients with coexisting organic disease. There were no diabetics in their study group. The blood pressure determinations were not remarkable. Blood serology was negative in all but one instance. Urinalyses were negative in all but 4 patients 1 of these was found to have occasional glycosuria, while 3 others showed evidence of urinary tract infection.

In 24 patients complete blood studies were made. In 8 of these the blood was normal 10 showed evidence of infection as indicated by an increased sedimentation rate, toxic granulations, or an increased white count. The study indicated that the changes noted were due to infection elsewhere in the body. Two patients showed pernicious anemia and 3 revealed idiopathic hypochromic anemia a higher incidence than that normally expected. Minor blood abnormalities were noted in 2 patients.

A study of the vaginal secretions showed only 1 patient with active trichomonas vaginalis vaginitis. Fast cultures were positive in 3 patients but clinical evidence of yeast infection was not evident in any of them.

Psychiatric consultation was obtained on 32 of the study group. While emotional instability is likely to be a factor in aggravating and prolonging the pruritic phase of the disease the authors could not assign a cause and effect relationship.

Chronic irritation is thought to be a factor in leucoplakia of the mouth a lesion similar to that of the vulva, but the authors have not yet been able to evaluate its role as an etiologic factor in the vulvar lesion.

Twenty five of the group were studied with reference to allergic manifestation 14 (56%) had no allergic history or recognizable sensitivity 11 (44%) revealed an allergic background of variable severity and in 2 the pruritus was somewhat relieved after removal of the allergen.

Because of the hyperkeratoses noted in vitamin A deficiency, the possibility of leucoplakia being a nutritional disease was considered. Blood vitamin A determinations were made on 10 patients and in only 1 instance was the level below limits accepted as normal. Blood plasma ascorbic acid levels were determined for 22 patients and in 14 (63.5%) the levels were normal or above.

Gastric acidity was noted in 12 patients and 6 had no free acid. Of the latter 2 patients had pernicious anemia. Since 25 per cent of the population over 65 years of age is believed to have no free hydrochloric acid and since one half of the women studied in this series, on whom the test was made, did have free hydrochloric acid the importance of the relationship would seem to be minimized.

Estrogen deficiency as an etiologic factor is not borne out by the authors' studies. This view is further supported by the fact that leucoplakia may exist without improvement in young women during pregnancy when the estrogen levels are normally high. In order to explore further the possibility of hormonal imbalance, urinary female sex hormone determinations were carried out on 20 women in the series. The findings were not sufficiently unusual to be significant.

The authors have found no entirely satisfactory cure for leucoplakia of the vulva. Treatment continues to be largely empirical and is aimed at the relief of symptoms. While operation has not yet been deemed necessary in any of the 36 patients in the group studied the authors state that surgery does have a very real place in the management of malignancy of the vulva and for patients with proved carcinomatous change whether on a leucoplakic basis or not they strongly advocate radical excision including inguinal lymphadenectomy.

JOHN R. WOLFE M.D.

The Treatment of Carcinoma of the Vulva J. L. McKEIVY. *Am J Obst* 1947 54 626.

There is still considerable confusion as to the effectiveness of the various forms of therapy which are being advocated and used for vulvar carcinoma. The author suggests that those who have to deal with the problem must decide on some form of attack. In the present article the attempt is made to evaluate the results of such a decision at the University of Minnesota Medical School Minneapolis to compare the results of the presently used radical vulvectomy with other types of procedures previ-

ously used and to prevent what information has come from the material in regard to the further extension of the surgical attack.

The material represents all of the vulvar carcinomas seen from 1938 to the end of 1946 and is classified into two groups. Prior to September 1938 the 36 patients were treated by a wide variety of measures including simple vulvectomy, unilateral and bilateral superficial removal and both superficial and deep gland removal, x ray therapy to the groin or to the vulva (or both) and radium or radon application to the vulva or groin. No single stage radical vulvectomy was used. Therapy was standardized in 1938, radical vulvectomy being applied to 38 of 41 patients (90.5%). The radical vulvectomy under local anesthesia is described.

In the early group 5 patients are alive and free of tumor 5 years or more after treatment, an absolute cure rate of 39 per cent. In the second series, 4 are alive and well more than 5 years after operation and 18 are alive and free of tumor for from 2 to 59 months, which is a significant improvement.

The author discusses some of the problems of the treatment of carcinoma of the vulva. There has been sufficient experience with early tumors treated by methods other than radical vulvectomy to make it clear that minor procedures are not satisfactory. Local excision or local irradiation has no place in the treatment of early tumors. It seems clear that carcinoma of the vulva, particularly that of the labia majora, is a generalized disease and that the multiple nodules or recurrences are more often new areas of tumor than metastases or residual tumor from the main mass. To remove the vulva alone is to fail to take advantage of perhaps the most important clinical feature of the disease, which is the fact that lymphatic metastases tend to remain for reasonably long periods of time in the inguinal and femoral regions without spreading beyond these areas. The presence or absence of palpable glands is no useful criterion as to the presence or absence of tumor in these areas. Contralateral involvement is so well known that the bilateral removal of glands needs no support.

The author energetically opposes gland removal for biopsy. It serves no useful purpose since the glands are to be removed intact later. It involves opening into possible tumor-bearing tissue and it can make clean removal of the gland-bearing mass impossible.

Of the 38 patients treated by radical vulvectomy the deaths of 4 have been charged as postoperative deaths, a mortality rate of 10.5 per cent. The author assumes that the mortality rate would be considerably higher if the operations were extended to include removal of lymphatic structures along the femoral and iliac vessels within the pelvis.

In view of the fact that there were 3 deaths from embolism among all of the patients, consideration will have to be given to vein ligation at the time of radical vulvectomy. This has not yet been done.

JERRY R. WOLFE, M.D.

MISCELLANEOUS

Studies on the Human Corpus Luteum. JON I. BREWER and HAROLD O. JONES. *Am. J. Obst. Gyn.* 54: 56

It is rather generally accepted that the life cycle of the human corpus luteum, the cycle of the endometrium, and the relationships of these two systems to one another are constant and are not subject to variations. During the active normal functional state, the authors believe that this is usually true. It is the purpose of the authors to demonstrate, and to discuss the clinical importance of a variability which does occur, however, in these two tissues and in their relationships during the regressive state principally near and just after the onset of menstruation each month. Endometrial studies are frequently made in an effort first, to determine the presence or absence of a corpus luteum, second, to estimate the functional capacity of the corpus luteum in preparing the endometrium for pregnancy, and third, to study corpus luteum activity in relation to abnormalities of the menstrual cycle. Without proper evaluation of the normal variations these clinical studies may be subject to misinterpretation.

The tissues for this study consist of the uterus with the endometrium and the corpus luteum in each instance. These surgical specimens were obtained from patients who had completely normal menstrual cycles and whose ages varied from 23 to 47 years. Three specimens obtained prior to the onset of menstruation were selected as representative of this period and 7 specimens removed from patients on their first day of menstruation are described and compared.

In the human corpus luteum degeneration of the granulosa lutein cells is first noted at from 4 to 6 days before the onset of menstruation (Brewer, 1942). This degeneration is a slow and gradual process and in its early phases can be a reversible reaction if pregnancy ensues. It is not a process that occurs suddenly at the onset of menstruation, and it does not typically involve all the cells of the granulosa lutein layer uniformly. The authors demonstrate variations in the histologic characteristics of the granulosa lutein cells in different corpora lutea and also in the same corpus luteum just prior to, and during the first day of menstruation. These variations represent normal differences in rate and extent of degeneration in these cells. Variations are also shown in secretory activity and in extent of desquamation in the different endometria and in different regions of the same endometrium just prior to and during the first day of normal menstruation.

Not only do these tissues vary among themselves but there is so much variation that an absolute constant pattern cannot be established. A study of the endometrium during this period in the cycle does not accurately reflect the histological picture of the corpus luteum. Similarly, the histologic study of the corpus luteum does not reflect the true state of the

endometrium. It is possible that during this phase of degeneration the histology of the *granulosa lutea* in cells may not reflect a true index of the degree of functional activity of the corpus luteum.

The observations reported have clinical as well as academic interest. Endometrial biopsies are being more and more frequently studied in endocrine and sterility problems. In the numerous reports the presence or absence of corpora lutea and the qualitative and quantitative functional capacities of the structures are estimated from the histology of the endometrium. On this basis clinical diagnoses are made and treatments instituted. In order that errors may be avoided it is necessary that the histologic variations in the relationship between the corpus luteum and endometrium be evaluated. This is particularly true since it is rather universally advocated that endometrial biopsies should be taken on the first day of menstruation and it is at this time that the variations are greatest. Accurate interpretation of functional activity can be obtained only by studying the endometrium during the actively functioning period of life of the corpus luteum and endometrium. Biopsies therefore must be taken at least 4 to 6 days prior to menstruation.

JOHN R. WOLFF, M.D.

A Simple, Rapid Method of Approximate Dosage of the Gravid Gonadotropins in Daily Practice
(Su di un metodo semplice e rapido di dosaggio approssimato delle gonadotropine gravidiche nella pratica clinica corrente) AQUINO MARTO *Chir. ital.* 1946 48 125

Wishing to bring the brilliant theoretical studies of Simonnet and of Brindeau Hinglais (1932-1937) to a point where they would have some practical application the author first attempted to improve the Aschheim-Zondek test for pregnancy so as to render it less time-consuming and expensive for quantitative test purposes. The requirements with regard to experimental animals have been reduced to 2 rabbits and these need not be sexually mature (weight, 2 kgrs. or more). Not yet mature and light animals (body weight in one instance 1,340 gm.) may be used provided that a preliminary laparotomy and examination of the ovaries is done. Blood serum of the patient is used as it is believed to be more constant in its content of hormone than the urine and less toxic for the animal. The results are estimated on the basis of the rabbit unit of Brindeau and Hinglais which is defined as the smallest amount of hormone injected intravenously into the ear vein of a rabbit weighing 2 kgrs. that will exhibit at least one hemorrhagic point in at least one ovary within 48 hours. The proportion between the rabbit unit of Brindeau and Hinglais and the Aschheim Zondek unit averages about 7.5 to 10.

The technique varies of course, with regard to the information sought, and any number of rabbits are used if the test seems to need further clarification. An illustrative case would be that of a pregnancy which is suspected from the history and clinical findings of

degenerating into a hydatidiform mole. One cubic centimeter of the patient's blood serum is diluted with 50 c.c. of physiologic saline solution. One of the 2 rabbits is then injected with 1 c.c. of this dilution and the other with 0.5 c.c. If the reaction in both animals is negative the mole can be excluded. If the 1 c.c. test is positive, and the 0.5 c.c. is negative, a vesicular mole may be suspected however not a living mole. Of course on the basis of the test alone this might also mean other things such as a toxicity of pregnancy which also exhibits at times a moderately elevated hormone titer in the blood. If both tests are positive then the presence of a living developing mole is certain and the uterus must be emptied. Now to turn this into Brindeau Hinglais units (U.B.H.)—the 1 c.c. of serum (1/1000th of a liter) was diluted 30 times and therefore the 1 c.c. rabbit would, if positive have received at least 60,000 U.B.H. and the 0.5 c.c. rabbit at least 30,000 U.B.H.

This method has been, and is being widely and reliably employed in the laboratory at Verona. Its desirability in cases of malignant degeneration of chorioepithelioma, in which the hormone titer tends to be constantly high as a control for the indications for hysterectomy is evident however no instances of this malignant development have come to light during the 3 years of the author's incumbency. In one instance, however a chorioepithelioma could be excluded and the hysterectomy avoided.

JOHN W. BRENNAN, M.D.

A Correlation between Vaginal Smear and Tissue Diagnosis in 1,845 Operated Gynecologic Cases.
N. PAUL ISRAEL, JOHN F. JEWETT, MALCOLM S. ALLAN, and ARTHUR T. HERRIO *Am. J. Obst.* 1947 54 376

The vaginal smear as a means of detecting uterine malignancy has been well established by numerous reports, but there are none regarding its value in a hospital devoted exclusively to the care of gynecologic patients. Therefore it has been the purpose of this study first, to determine the relative value of the vaginal smear in the discovery of cancer as compared to cervical biopsy and curettage, secondly, it was desired to test the practicability of the method with reference to the amount of special training the pathologist and allied personnel would need and the time they would consume in reading the smears.

Vaginal smears were prepared and stained according to the technique of Papanicolaou and were obtained before vaginal examination was performed. All smears were interpreted by one of the authors who was in complete ignorance of the clinical history and the tissue diagnosis at the time of the reading. In all cases the first smear was recorded as either positive or negative. Such interpretation on any given case was the only one used for the purpose of this study irrespective of whether or not another observer agreed with this initial diagnosis. Every field on every slide was completely examined. In suggestive smears this was done under high power

magnification whereas it was possible to scan less suspicious smears with the low power objective using the high power only on questionable cells.

In 1,000 cases, comprising those in which the tissue diagnosis was unquestionable 60 malignancies of the uterus, cervix or vagina were encountered. In 40 patients with carcinoma of the cervix, 39 were found to have positive smears the smear was negative 1 patient representing an error of 2.5 per cent. In 18 malignancies of the uterus, 15 smears were positive and 3 were negative giving an error of 16.6 per cent. Two carcinomas of the vagina were encountered and both had positive smears with no error. The total error of positive cases called negative is 6.66 per cent. In the remaining 940 cases with negative tissue sections, there were 11 false positive vaginal smears an error of 1.17 per cent. The total combined error of false positive and false negative smears is thus 1.5 per cent.

A second group consisted of 4 cases in which the diagnosis might be at variance with that of other pathologists and is therefore considered equivocal. Eight positive and 5 negative smears were encountered in 3 carcinoma *in situ* of the cervix. Only 1 positive smear was found in 7 carcinomas *in situ* of the endometrium. Four positive smears were encountered in 13 questionable carcinoma *in situ* of the cervix. No positive smear was found in 8 questionable carcinoma *in situ* of the endometrium.

The third group contains 4 cases in which malignancies were encountered elsewhere than in the uterus, cervix, or vagina. These incidental malignancies

are not included with the others because their diagnoses do not seem to be applicable to the vaginal smear technique.

From their results, the authors concluded that the vaginal smear method is an accurate and reliable adjunct to a gynecologic clinic. Since the method is actually applied daily would undoubtedly provide the observer with clinical information which the authors purposely avoided its accuracy could be reasonably expected to increase, largely by the avoidance of false positive readings. It is further significant that only one of the four false negative readings occurred because malignant cells were initially unrecognized although present, hence the other three have been repeatedly re-examined without the discovery of malignant cells, thus indicating an irreducible error inherent in the method.

Each of the examiners, previously experienced in tissue diagnosis, after studying the available literature, spent about 3 weeks under intense training in the vaginal smear method. The time consumed in reading varied tremendously and the process itself was much longer and far more tedious than the corresponding tissue examination. It is roughly estimated that average smears required from 15 to 20 minutes apiece, while in some particularly difficult smears it would require up to 2 hours; however, a second smear might not be as difficult as the first.

The authors note that the method proved most perfectly valuable in the study of early carcinoma and carcinoma *in situ* as well as in the diagnosis of more advanced cases.

JOHN R. WORTH, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

The Treatment of Eclampsia and Pre-Eclampsia with Veratrum Veride and Magnesium Sulfate
FREDERICK C. IRVING. *Am J Obst.*, 1947 54 731

Thirty years ago the delivery of an eclamptic presented no problem to the obstetrician. According to his simple philosophy the woman was having fits because she was pregnant, and if she ceased to be pregnant there would be no reason for her to have fits. Therefore he emptied her uterus forthwith usually by manual dilatation of the cervix followed by forceps or by version and extraction. About 30 per cent of the patients died usually from shock and hemorrhage. As cesarean sections became more common they were performed on eclamptics but with even worse results for the death rate then rose to 40 per cent.

In the middle 1920's a change from radicalism to conservatism began with the reports of Stroganoff and Lazard each of whom described the control of convulsions without active immediate interference the former using morphine, chloral and chloroform while the latter introduced the intravenous use of magnesium sulfate. In 1935 Bryant and in 1940 Bryant and Fleming reported the use of veratrum veride and magnesium sulfate in the treatment of eclampsia. Their results in two large series of cases were so much better than any published in America that the Boston Lying In Hospital decided to adopt Bryant's program. It is with the outcome of their series of 33 cases that this paper is concerned.

The little known pharmacology of veratrum veride is discussed in detail.

The patient is placed in a quiet darkened room with a nurse in constant attendance. Morphine one-fourth grain demerol 100 mgm subcutaneously, or 3 drams of paraldehyde in 2 ounces of mineral oil are used to control restlessness but are not given routinely. Five minims of veratrine are given hypodermically on admission. Veratrine is repeated as necessary in 5 to 10 minute doses at 20 minute intervals to keep the blood pressure below 150 systolic and the pulse below 80 or in the event of a convulsion. Magnesium sulfate in 50 per cent solution is given intramuscularly into the buttocks 10 to 20 c.c. every 4 to 6 hours. To encourage urinary secretion 250 c.c. of 25 per cent glucose in buffered sterile water are given slowly every 4 hours if the patient is unconscious. If she is conscious it is given every 6 hours. In a few instances the author found the use of salt poor albumin in 50 gm doses to be followed by a marked increase in urinary output and the disappearance of edema. The results with plasma have not been so satisfactory. Enough parenteral fluid is given to prevent dehydration and not enough to cause edema. If the patient is conscious she is given 2000 to 3500 c.c. of water every 24 hours.

Pregnancy is terminated only after the convulsions have ceased and an interval of 24 to 72 hours has elapsed. If the cervix is partially effaced and dilated enough to admit one or more fingers the membranes are artificially ruptured. If not a Voorhes bag is introduced. Cesarean sections are performed only on strictly obstetric indications such as cephalopelvic disproportion or placenta previa. Once induced labor is allowed to proceed normally and to terminate, if the presentation is vertex either by normal delivery or low forceps. Ether with oxygen is usually employed for normal deliveries and low spinal anesthesia for operative deliveries.

Thirty two patients with eclampsia were treated from 1940 to 1946 inclusive. There were 2 maternal deaths a mortality rate of 6.3 per cent. Both deaths occurred in neglected emergency cases admitted from small outside hospitals, both patients were moribund on entrance and died soon afterwards. The author states there is no cure for the grossly neglected eclamptic who arrives at the hospital breathing her last. The damage has already been done and nothing will save her life.

JOHN R. WOLFF, M.D.

Treatment of Placenta Previa. The Maternal and the Fetal Aspect. JOHN STURROCK, HUGH STIEL, IMA and ROBERT A. TENNENT. *Edinburgh M J* 1947 54-496

A review of cases of placenta previa observed in the Edinburgh Royal Maternity Hospital and the Simpson Memorial Pavilion of the Royal Infirmary Edinburgh during the years from 1926 to 1945 is given by STURROCK.

Table I compares the maternal and fetal mortality in the different 5 year periods. It shows a fall in the maternal mortality which is striking and a fall in the fetal mortality in the last two 5 year periods which is not so dramatic as the improvement in the maternal figures. Comparisons are then made of the results of the different methods of treatment in the various 5 year periods. After 1930 cesarean section became much more popular and was usually employed in most of the cases of placenta previa which were more than marginal in scope and in which the child was viable. Mere rupture of the membranes was generally used in cases of marginal or lateral placenta previa. In Edinburgh the use of Willet's forceps for scalp traction has remained quite popular as a substitute for bringing down a leg.

Since 1940 transfusion has been used much more frequently and apparently with good effect. The infection rate has also dropped as the years have passed, possibly through the use of the sulfonamides. Also since 1940 the policy of delaying active treatment has been employed more often with the hope of achieving maturity for the fetus. Because of this and the more frequent use of cesarean section the

TABLE I

Years	Numbers	Maternal deaths	Fetal deaths		
			Total	After 48th week	
		Per cent	Per cent	Per cent	
9	54	1.98	7.67		
10-20	68		20.98	29.12	32
21-30	209	7	12.67	63.12	63
31-40	70	0	12.29	25.71	26
41	18	8	12.5	20	7

fetal mortality has decreased considerably. However, delay is considered to carry certain added risks for the mother and is employed with some misgivings.

STIRLING reviews the cases of placenta previa admitted to the Glasgow Royal Maternity Hospital during the period from 1911 to 1946. He considers the maternal aspect of these cases. This series consisted of 55 cases, of which 222 were classed as mild (lateral) and 283 as severe (marginal complete, and central). Third stage complications were of frequent occurrence. There were 24 cases of postpartum hemorrhage in the mild group an incidence of 0.8 per cent, and only 8 cases in the severe group an incidence of 2.8 per cent. (The latter figure is explained by the fact that most of the patients with severe cases were treated by cesarean section.)

Blood transfusion was employed in 109 cases, i.e. in 21 per cent of the total series or in almost 30 per cent of the severe group alone.

There were 8 deaths, a mortality rate of 3.6 per cent. In the mild group (22 cases) there were 4 deaths 1.8 per cent mortality. In the severe group (283 cases) there were 14 deaths, 5 per cent mortality. Hemorrhage and shock occurred in 8 cases, and shock was due to postpartum hemorrhage in 3. 3 women died under anesthesia, on the operating table. In addition 1 woman died (undelivered) of acute cardiac failure and 1 died (undelivered) following an incompatible transfusion. Excluding all "non-notifiable" condition the morbidity rates were 0 per cent for the total series, 5.4 per cent for the mild group and 3.8 per cent for the severe group.

The results obtained with different methods of treatment were classified, and the following figures abstracted:

Mild Groups	Cases	Deaths	Per cent	Morbidity
N. treatment	20		66	5
V.B.M.	65		3	0
Packing	3			
Vernon	7			
Cesarean section	27			5

The question of delayed treatment was considered. If treatment was postponed for more than 24 hours it was considered delayed.

In general terms the figures appeared to show that some slight but definite added risk to the mother ensued when delay in treatment was adopted.

The fetal aspect of the same cases is given in TENNENT. There were 507 infants born in the case of placenta previa which Stirling discussed. Of these 334, or 65.9 per cent, left the hospital alive, 77.15 per cent, were stillborn and 66 or 18.9 per cent, died during the neonatal period. Thus, the combined stillbirth and neonatal death rate was 34.1 per cent.

In the cases of mild placenta previa 220 babies were born and 74.5 per cent of these survived. The corresponding figure for the 287 infants born in the severe group was 59.2 per cent. These figures supported the already well known fact that prematurity was the major danger to the infant in placenta previa.

Suggestions for decreasing the fetal mortality are:

1. Attempt to ensure that the infants attain a birth weight of 6 lbs.

2. Attempt to ensure the survival of the maximum number of infants born who weigh under 6 lbs.

3. Try to decrease the stillbirth rate.

The most noteworthy fact in the analysis is that in the cases of severe degree treated by cesarean section within 24 hours, 68 per cent of the infants left the hospital alive which was satisfactory.

The results in the cases in which cesarean section was delayed 24 hours or more were much less satisfactory.

The results were generally worse in the delayed group. It would therefore appear that to insist on delayed treatment on behalf of the child is a speculative procedure.

Conclusions. From the examination of these cases from both the maternal and fetal aspect, it was concluded that fetal survival appears no more certain in the delayed than in the immediate group, and as the maternal mortality and morbidity are slightly increased in the delayed group, delay in the treatment of placenta previa is not a justifiable procedure in the majority of cases.

The authors feel strongly while admitting the place of expectant treatment in placenta previa, that it should be reserved for elderly primigravidae and women with no living children.

DANIEL G. MONTOM, M.D.

Two Cases of Neurologic Affection Complicated by Pregnancy Diseminated Sclerosis; Myasthenia Gravis Pseudoparalytica (Zu zwei Fällen von affektion neurologische compliciert in gravidanza [Sclerosis plachbe—myasthenia grave pseudoparalytica]). L. BERNARDI GIAMAROLI. *Riv Ital gine.*, 1946, 29, 167.

Two instances of neurologic ailments complicating pregnancy although entirely different in most regards, are here reported together in order to illustrate the need for individualization in the prognosis and treatment of this type of patient. In both, the condition was rather recent in onset nevertheless complete examination and assessment could be accomplished before the initiation of the complicating

pregnancy. In both cases the patients had been pregnant for a period of about 2 months before coming under the author's care.

The patient with disseminated sclerosis was 21 years of age. She remained in excellent physical condition and it was decided to let her go on to delivery at term. The first stage of labor was somewhat prolonged however not longer than would be expected of a primiparous woman. A living child of more than 7 pounds body weight was born. During the later part of the pregnant period some edema developed about the involved extremities chiefly on the left side, and some evidence of involvement of the seventh cranial nerve was observed also a small pale area, not previously noted, appeared beside the papilla in the right eye. After delivery the edema largely cleared up and the other manifestations have remained stationary up to the end of the follow up period 4 months later.

The symptoms of the patient with myasthenia gravis became steadily worse following the onset of pregnancy she was absolutely bedfast and compelled to sit up in bed because of difficulty in breathing. A therapeutic abortion in the second month of pregnancy was decided upon. Following operation the patient has actually improved in the year since the operation she is now able to be up and about at her work part of the day and when at rest is able to lie flat in bed. The drugs usually employed in myasthenia gravis (prostigmine, strychnine) did not give the expected results, and this failure is ascribed by the author to the pluriglandular imbalances of the pregnant state. From this, then, the author goes on to speculate on the possibility that these imbalances may be at the root of the deleterious influence of pregnancy on these neurologic conditions.

JOHN W. BREKKE, M.D.

Myomatosis and Pregnancy (Míoma y embarazo)
C. COLMEIRO-LAFORET *Rev espal. obst.*, 1947 4
260.

Nine cases of pregnancy in myomatous uteri form the basis for this review of the subject. The youngest of the women was 20 years old. Seven delivered a living child spontaneously at term. The only mortality was that of 2 fetuses. In both instances hysterectomy was done one at 3 months for acute necrosis of one of the myomas and the other at 8 months in completing a cesarean section for retinitis albuminacea.

Since the author realized that definite conclusions are impossible with such meager material he studied the extensive material on this subject in the general medical literature. Even so the conclusions suggested cannot be taken too literally since the progress in obstetrical and surgical methods in the past few years has motivated a swing toward conservatism in the treatment of myomatous pregnant women and this has produced an improvement in the results however this improvement has not as yet become clearly defined. Then again the multiplicity of factors intervening in the diagnosis, rec-

ognition of complications, prognosis and treatment makes it extremely difficult to lay down any sort of general rules of procedure. The rare concurrence of myomatosis and pregnancy (in 0.5 per cent of all pregnancies) may be the result of some unfavorable influence on the fertility of the myomatous woman but it may also be due to the fact that the younger women with greater natural fertility do not tend to develop fibroids which would become of consequence in pregnancy. The tumors themselves may tend to grow rapidly during pregnancy or the rapid increase in size may be merely a passive increase due to the imbibition of more fluids from the enlarging and more succulent uterus itself. The tumors certainly tend to become softer and more yielding to the touch during the pregnancy and to regress and often disappear afterward. The fact that fibroids of the cervix or vaginal wall are so rarely of a size or in a location to cause dystocia may be explained by the fact that the uterine fundus has so much more muscular tissue to produce more and bigger tumors. The course of labor in the myomatous woman is certainly prolonged but it is not markedly longer than that in elderly primiparas in general. The presence of fibroids seldom exerts any decided effect on the position of the fetus in utero or even during labor. A large myoma may get in front of the presenting part and threaten to interfere with the descent, engagement or expulsion of the birth products; however, it happens that the foregoing tumor mass is expelled ahead of the presenting part or in its pliable resiliency slips back up into the uterine cavity and leaves the birth passages free. During this period rotation, necrosis and rupture of the myoma do not occur as often as the general instability of the uterine muscular walls in which it is immured would suggest. In fact, these complications—including the development of infection—occur much more frequently during the puerperium.

The one generalization which can be made with great certainty with reference to the treatment of these pregnant myomatous uteri is that they are a definite threat to the pregnant woman. She should be subjected to close and unremitting watchfulness. Placenta previa is disturbingly common in this condition and is probably to be explained on the basis of the changed nutritive or circulatory conditions over the area of implantation of the myoma. This either makes difficult the implantation of the placenta up in the fundus where the myoma is attached, or necessitates an enlarged area of implantation of this organ. The most constant early symptom of the degenerating myoma is the area of localized tenderness and pain.

Whether any one symptom or syndrome indicates surgical interference will depend upon a number of considerations but will in general not differ essentially from the indications such as similar obstructive or toxic processes of other nature. Many of these cases are successfully managed by conservative measures however if the tumor mass because of its

threat of obstructing the process of delivery or for other reasons, should seem to demand some active interference, cesarean section in the presence of a viable child seems to be the best answer. Even in the presence of a nonviable child the prospects for a successful myomectomy in the course of the pregnancy would not seem very good, since the incidence of abortion following these myomectomies is more than 1 in 3. If cesarean section is done it should not be completed by a myomectomy because the maternal mortality is from 12 to 25 per cent. If removal of the myoma seems necessary a hysterectomy should be chosen since the maternal mortality under these circumstances is not notably higher than that for the cesarean operation itself.

JOHN W. B. FROXY, M.D.

LABOR AND ITS COMPLICATIONS

Low Spinal Nupercaine Anesthesia in Obstetrics.
II. BERT E. SCHMITZ and GI. BABA. *Am J Obstet* 9:17-54, 1938.

The authors present the results of their study of 375 cases of low spinal anesthesia at Lewis Memorial Maternity Hospital, Chicago, Illinois. The patients were carefully evaluated as to contraindicating factors which the authors list.

The technique of administration is described as follows:

Small doses of hyperbaric nupercaine solution provided satisfactory analgesia of at least one hour's duration in 370 patients. Perineal anesthesia, percutaneous episiotomy and episiorrhaphy lasted on the average from 3 to 4 hours, but in a few cases was found to be present as long as from 7 to 10 hours. Recurrence of abdominal pain, however, appeared after 2 to 3 hours, and in some cases within 2 hours. Complementary and supplementary injections were

generally more effective in maintaining analgesia over a longer duration than the initial administration.

Hypotension requiring the use of ephedrine occurred in 13 patients, and in 2 of these "reactions" (hypotension, bradycardia, pallor, cold sweat, and fetal heart irregularity) developed which responded satisfactorily to the administration of oxygen and ephedrine. In all of the patients some motor excitement was present.

The area of anesthesia and hyperesthesia described a saddle pattern over the legs and perineum and extended over the abdomen to various segmental levels, for the most part below the level of the eleventh thoracic nerve. Blood loss at the time of delivery was usually small, but, as the minimal dose of nupercaine was not always used, no conclusions can be drawn.

In all cases but 6 the babies were awake, breathe, and cried as soon as the heads were delivered. There were 3 stillbirths. In 2 cases, the patient gave birth to twins, in each of which one twin was a macerated stillborn infant. In both of these cases the labor was premature. Fifty-two patients developed headaches on various days of the puerperium. A neurologic complication in the form of drop foot occurred once.

The authors conclude that low spinal anesthesia and analgesia is the anesthesia of choice in obstetrics. It is definitely satisfactory to the patient and her relatives, to the nursing staff, and to the obstetrician because of the dramatic and effective relief of the discomfort of labor, the maximum safety it provides the fetus and the mother, and the simplicity of the technique which utilizes a minimum of paraphernalia. It is imperative that the most careful technique be closely observed.

JOHN R. WOLFF, M.D.

GENITOURINARY SURGERY

ADRENAL KIDNEY AND URETER

Adrenal Tumors and Pseudohermaphroditism: A Hormone Study of Cases. A. M. HAIN, J. POSE
Brit. Med. J. 1947 59 267

Progesterone, androgens and estrogens have been isolated from the adrenal cortex and recovered from the urine of persons suffering from abnormal function of the adrenal cortex. Androgen secretion is particularly increased in hyperplasia or neoplasia of the adrenal cortex giving rise to the clinical picture of virilism. The author confines himself in the present report to a study of adrenal cortical tumors and to patients with disordered cortical function occurring antenatally which affects sex development at the outset. He expects to report at a later date on the group which manifests some or all of the signs and symptoms of virilism after maturity (the adrenogenital syndrome). The group now described comprises male and female pseudohermaphrodites the former with the gonads of the male the latter with those of the female.

Since the clinical picture of virilism varies markedly in relation to the extent or type of the cortical lesion the author stresses the importance of hormonal studies of patients with symptoms of virilism. He reports in detail the method of Latterson and his associates (1942) for the estimation of 17 ketosteroids. With the use of this method in the cases of 6 patients with adrenal cortical tumor, he found a high androgen (17 ketosteroids) output in all but 1 patient, and an increased production of progesterone (pregnandiol) in some. In spite of the production and excretion of large amounts of ketosteroids and pregnandiol one patient in the series reconstructed four times during the last 8 months of life. While numerous reports of vaginal bleeding in children with adrenal tumors are recorded and in very hirsute women in whom marked adrenal hyperplasia was present, menstruation in adult women with adrenal tumors is exceedingly rare. The excretion of a pregnane derivative other than pregnandiol was noted in one of the patients in the present series as well as hypertension however the latter is said to be the rule in patients with adrenal cortical tumors or hyperplasia. As a result of the excess eosinophils observed in the histological sections of the pituitary in one case of adrenal cortical tumor the author suggests that adrenal hyperfunction can cause an excess of either the basophil or eosinophil cells of the pituitary gland.

Adrenal tumors or hyperplasia occur not infrequently in more than one member of a family. The occurrence of these tumors in the male is rare.

The author presents 8 cases of pseudohermaphroditism in which doubt existed at birth as to the correct sex of the infant. It is suggested that on the basis of the 17 ketosteroids in 6 of the 8 cases a

differential diagnosis between male and female pseudohermaphroditism might be made. In the latter hyperfunction of the adrenal cortex persists and is responsible for the condition manifesting itself in the excretion of excessive amounts of ketosteroids and sometimes pregnandiol. In the former on the other hand the ketosteroid output is either normal or slightly raised the condition having arisen and been completed antenatally.

The relationship between the hormonal output and the form of adrenal cortical abnormality as an aid in the differential diagnosis is discussed as well as antenatal sex alterations resulting from adrenal cortical changes. Hyperactivity of the androgenic function of the adrenal cortex both antenatally and postnatally has a profound influence on the sex characters of both sexes the tendency being a virilizing one in which the female characters are suppressed and the male accentuated. In cases in which male characters are weakened e.g. in male pseudohermaphrodites it is feasible to suppose that the androgenic function was either weak or late in being established.

PETER L. SCARDINO, M.D.

A New Operation for the Treatment of Hydronephrosis in Association with a Lower Polar (or Aberrant) Artery. H. HAMILTON STEWART. *Brit. J. Surg.* 1947 35 5

The author has always considered that the standard operation for hydronephrosis due to obstruction caused by a lower polar artery did not satisfy the ideals of surgery. If the vessel is large its division carries with it the dangers of infarction of the kidney with loss of tissue and the tendency toward infection. Imperfect drainage is another hazard with the risk of persistence of infection introduced through drainage tubes. Stenosis of the ureter with fistula formation may also occur.

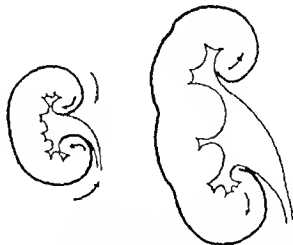


Fig. 1. Diagram showing the changes in shape of the kidney and pelvic relationship which occur with growth.

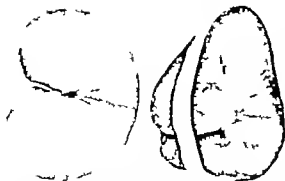


Fig. 1 (Stewart) Photographs of clay models illustrating the apposition of the anterior surfaces of the poles of the kidney so that adhesions may develop over a broad surface and retain the kidney permanently in its new shape.

The author does not agree with the view of some surgeons that an aberrant artery is a minor factor in obstructions at the ureteropelvic junction and that a congenital stricture (or neuromuscular defect) at this point or elsewhere along the ureter plays an important part.

In the infant the kidney is arched upon itself to such an extent that the two poles approach each other closely over the enclosed pelvis. If a lower polar artery is present it will lie in close relation to the main renal artery and in this position it is unlikely to produce obstruction. As the kidney develops the poles diverge and the lower polar artery becomes separated from the renal artery and is capable of producing obstruction (Fig. 1).

The author has, therefore, devised an operative procedure in which he aims to re-establish the condition in the kidney present in infancy and since the artery is not divided and drainage tubes are not employed, to avoid many of the hazards of the older operations. The underlying principle of the operation is the molding of the kidney so that the lower polar artery shall come into close relationship with the renal artery. In this position the former is no longer capable of producing obstruction.

The pelvis and ureter are carefully dissected free from the lower polar vessels. The prolapsed pelvis is raised over the obstructing vessels and gentle traction is exerted on the ureter in its long axis to allow the pelvis to drain. If the hydronephrosis is large and the tension is considerable aspiration with a needle through relatively normal renal tissue is carried out. The capsule is reflected from the front of the upper and lower poles of the kidney and is left attached at the convex margin. The kidney is grasped in both hands and the upper and lower poles are brought together so that the kidney now approaches a ball in shape. Plain four-0 catgut sutures (about 5 in number) are now placed through the upper and lower lobes. Ribbon gut (hardened) is now threaded under the capsule along the new concave border of the newly shaped kidney like the rim around a wheel. The hoop of catgut is fixed to the

front with sutures. The tape must be perfectly flat. The plain catgut sutures are now tied lightly (Fig. 2).

The two pieces of reflected capsule are brought together and sutured. Traction is now placed on the long axis of the ureter and if dissection has been adequate the pelvis will come to lie mainly below the aberrant artery which should now lie in close proximity to the renal artery.

The pelvis is plicated at the front and back with interrupted to day six-0 catgut sutures, so placed that they do not pass into the lumen of the pelvis.

The kidney is replaced and the renal space is drained for 48 hours. Nephropexy is not performed.

The author has carried out this procedure in 15 cases with excellent results.

FREDERICK A. LLOYD, M.D.

Chorioepithelioma of the Kidney (Corioepithelioma del riñon) PEDRO MEL CARDOZA. *Boletín de Obstetricia*, 1947 9 9

A 41 year old white woman had delivered 9 healthy children and had had one abortion between the fourth and fifth normal pregnancies. The last pregnancy ended after 8 weeks with the expulsion of a hydatidiform mole. Two months later following an unsuccessful curettage for continued bleeding, a hysterectomy was done. In none of these operations was a histological study made. For 4½ years afterwards the patient remained perfectly well and without evidence of recurrence or metastasis. Then hematuria appeared a tumor of the right kidney was diagnosed, there were two Hoggren frog tests for chorioepithelioma both of which turned out strongly positive and nephrectomy was decided on.

The extirpated right kidney was about the size of normal, roughly globular or oval in shape and dark red in color. Despite the fact that most of the kidney tissue had been replaced by the new growth, the capsule was intact except for some nodules of tumor tissue protruding along the posterior border of the organ. Histologic study failed to disclose any evidence of normal kidney tissue except for a strip of uninvolved upper pole about an inch in width, where one normal calyx and the narrowly compressed kidney pelvis leading up to it were discerned. The rest of the mass showed extensive necrosis, hemorrhage and round cell infiltration which probably accounted for the tendency to felleble reaction in the patient. However, in well preserved areas the tumor structure was found to consist of a delicate connective tissue supporting structure extensive lacunae filled with blood and the characteristic parenchymatous structure consisting of irregular shapes and sizes of cells resembling Langhans cells, with abundant, pale, reticulated cytoplasm and large rounded nuclei with well defined nuclear membrane and granules of chromatin, and here and there a mitotic figure. There were also bands of deeply staining ill defined (syncytial) masses of cells with irregularly placed small, darkly staining nuclei.

The author believes that this tumor is an example of atypical chorioepithelioma, according to the origi-

nal classification of Marchand or a chorioncarcinoma according to Ewing. He believes that it arose as a metastasis from a chorionepithelioma of the uterus, or a dissemination of villi from the hydatidiform mole to the kidney which lay dormant for $4\frac{1}{2}$ years and then underwent malignant degeneration.

It is believed that nephrectomy was the only treatment indicated for this favorably located kidney tumor although it is admitted that irradiation therapy has given surprising results. A combination of surgery and irradiation for tumors of this nature which cannot be entirely removed surgically offers promise for the future. JOHN W. BRENNAN, M.D.

Ureteral Diverticulum ORMOND S. COLE, *J Urol.*, Balt. 1947 58 309.

The literature on ureteral diverticulum was reviewed and the author found that at least 7 types of ureteral anomalies have been erroneously reported in the past as ureteral diverticula. By using his criterion for the diagnosis of a true diverticulum (ovoid or round extraureteral congenital sacs which contain all the ureteral coats and communicate through a distinct stoma with the ureter) he was able to collect a total of 10 cases from the literature. Five additional cases were observed in which the diverticula were acquired following stricture, calculi and trauma.

In this condition there are no typical subjective or objective signs and there is no uniform positional distribution relative to the ureter or preference of side or sex. The treatment is dependent upon the immediate condition or location of the ureteral diverticulum, the ureter, the size of the diverticulum and the associated pathology. Surgical therapy may include ureteral reimplantation into the bladder end-to-end anastomosis of the ureter or nephroureterectomy.

An instance of left ureteral diverticulum of congenital origin in a 20 year old male is reported. Due to an associated hydronephrosis the patient was treated with nephroureterectomy with complete recovery.

The article is excellently illustrated and the 10 instances of congenital ureteral diverticula are tabulated. ROBERT LICH, JR., M.D.

BLADDER, URETHRA AND PENIS

Cancer of the Bladder BENJAMIN S. BARRINGER, *J Am Urol Ass.*, 1947 135 616

Barringer implants screened radon seeds by means of needles through the cystoscope or the cystostomy wound using radon seeds of 1.5 mc. about 0.75 cm apart, going to the edge of the tumor but not beyond. The greater the tumor induration the deeper the seeds are implanted. Bladder vault tumors are preferably removed by open excision. In small post-operative recurrences radium implantation should be employed but numerous closely placed seeds should be used. Tumors at the ureteral orifices should be treated exactly as if they were situated at any other area of the bladder.

The follow up treatment and handling of bladders which have had radium implantation often determines whether or not the tumor will be controlled. Other than radium therapy, operative tumor removal and total cystectomy are used for vesical tumors. Total cystectomy should be reserved for tumors which have many points of origin throughout the bladder, such as papillomas, papillary carcinomas, and infiltrating carcinomas. For the large single infiltrative cancers which occupy a large part of the bladder and extend down to the vesical base, Barringer doubts whether total cystectomy can result in more cures than can be obtained by any other method; such tumors are usually incurable by any known means. It is difficult to diagnose accurately vesical tumors from small specimens taken from the surface of the growth. When only a part of the tumor is obtained the pathologic diagnosis must be modified by the clinical observations to give the true diagnosis. In tumors graded in this fashion the percentage of 5 year cures of papillary cancers was 52 per cent and of infiltrating cancers, 23 per cent.

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Since the bladder has a rich network of lymphatics with some intercalated lymph nodes it is possible that the disease started in one of these nodes. The possibility of primary origin of lymphosarcoma in the bladder fits into the clinical and pathologic findings of the case described in this article.

The course of all types of sarcoma of the bladder after surgery is usually rapidly fatal. The only therapeutic hope lies in the early employment of radical surgery combined with irradiation. This is true in the cases of all lymphadenopathies. The results of excision combined or followed by irradiation of the primary lesion are far superior to those of conservative treatment or the single use of irradiation or surgery.

ROBERT TURKILL, M.D.

Total Cystectomy CHARLES C. HIGGINS, *J Am Urol Ass.* 1947 135 619

In the consideration of radical treatment for carcinoma of the bladder 4 surgical procedures for diversion of the urine are available: (1) ureterosigmoidostomy (2) nephrostomy (3) pyelostomy and (4) cutaneous ureterostomy. The latter is preferable if ureterosigmoidostomy is not done. Other factors to be considered in arriving at a decision whether or not to perform total cystectomy are early diagnosis, the results which might be secured by less radical types of treatment, the site of the lesion, whether one or both of the ureteral orifices are involved by the growth, gradation of the tumor.

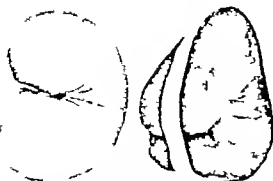


Fig. (Stewart) Photographs of clay models illustrating the apposition of the anterior surfaces of the poles of the kidney so that obstructions may develop over broad surface and retain the kidney permanently in its new shape.

The author does not agree with the view of some surgeons that an aberrant artery is a minor factor in obstructions at the ureteropelvic junction and that a congenital stricture (or neuromuscular defect) at this point or elsewhere along the ureter plays an important part.

In the infant the kidney is arched upon itself to such an extent that the two poles approach each other closely over the enclosed pelvis. If a lower polar artery is present it will lie in close relation to the main renal artery and in this position it is unlikely to produce obstruction. As the kidney develops the poles diverge and the lower polar artery becomes separated from the renal artery and is capable of producing obstruction (Fig. 1).

The author has therefore devised an operative procedure in which he aims to re-establish the condition in the kidney present in infancy and, since the artery is not divided and drainage tubes are not employed to avoid many of the hazards of the older operations. The underlying principle of the operation is the molding of the kidney so that the lower polar artery shall come into close relationship with the renal artery. In this position the former is no longer capable of producing obstruction.

The pelvis and ureter are carefully dissected free from the lower polar vessels. The prolapsed pelvis is raised over the obstructing vessels and gentle traction is exerted on the ureter in its long axis to allow the pelvis to drain. If the hydronephrosis is large and the tension is considerable aspiration with a needle through relatively normal renal tissue is carried out. The capsule is reflected from the front of the upper and lower poles of the kidney and is left attached at the convex margin. The kidney is grasped in both hands and the upper and lower poles are brought together so that the kidney now approaches a ball in shape. Plain four-o catgut sutures (about 5 in number) are now placed through the upper and lower lobes. Ribbon gut (hardened) is now threaded under the capsule along the new convex border of the newly shaped kidney like the rim around a wheel. The hoop of catgut is fixed at the

front with sutures. The tape must be perfectly tight. The plain catgut sutures are now tied lightly (Fig. 2).

The two pieces of reflected capsule are brought together and sutured. Traction is now placed on the long axis of the ureter and if dissection has been adequate the pelvis will come to lie mainly below the aberrant artery which should now lie in close proximity to the renal artery.

The pelvis is plicated at the front and back with interrupted 10 day six-o catgut sutures, so placed that they do not pass into the lumen of the pelvis.

The kidney is replaced and the renal space drained for 48 hours. Nephropexy is not performed.

The author has carried out this procedure in 15 cases with excellent results.

FREDERICK A. LLOYD, M.D.

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presence or absence of serious renal disease, and finally the age and general condition of the patient. In only 27.5 per cent of the author's series was complete excision possible without reimplantation of the ureter into another part of the bladder or without injury to the bladder neck. Many tumors are amenable to transurethral resection without or with radium seed implantation.

The mortality following total cystectomy is comparable to that in extensive operations for malignant lesions of the abdominal viscera. In many instances the poor end results are attributed to selection of cases. Abdominal exploration for metastases is routine. Higgins prefers primary transplantation of one ureter followed by secondary cystectomy and transplantation of the other ureter. In a younger person with good renal function a one-stage operation is performed. Abdominal excision suffices when the lesion is relatively far from the bladder neck; if the latter is involved abdominoperineal resection is used. Cystectomy and transplantation of the ureters into the rectosigmoid are now recommended under the following conditions:

1. No evidence of distant metastasis on abdominal exploration. Ureters too extensively involved that iliac nodes may be removed by block dissection.
2. The carcinoma is located on the floor of the bladder and the ureteral orifices are encroached upon, and the outlet of the bladder is so involved that if the cancer were to be locally treated by any method destructive action on the ureteral orifices, loss of vesical function and incontinence would result.
3. More extensive single or multiple infiltrating tumors are present.
4. Multiple recurring tumors develop rapidly and cannot be controlled by fulguration so that they eventually fill the bladder.
5. High grade malignant neoplasms are confined to the bladder.
6. It is obvious that renal function is adequate and distant or extensive local extension is absent.

DAVID ROXBOROUGH, M.D.

GENITAL ORGANS

Residual Prostatitis after Chemotherapy of Acute Gonorrhoea. F. C. BOURCAULT De COUDRA. *Brit M J* 1947 65

Subacute and chronic residual prostatitis are not uncommon sequelae of acute gonorrhoea treated with chemotherapy and/or antibiotics. The sequelae are symptomless signs including urethral discharge of a varying character, containing few pus cells with secondary organisms but no gonococci and with threads of mucus in the urine. The prostate is abnormal in size, shape, and consistency and, on massage, produces a pathological excess of pus cells without organisms. The author believes that the prostate should be evaluated by rectal palpation before starting treatment in cases of acute gonorrhoea.

Infection of the prostate apparently occurs very early in the course of the disease and may appear

clinically either before or after treatment when the gonococci have been destroyed. Prostatitis is more common than folliculitis which occurs characteristically in untreated gonorrhoea of at least 3 weeks duration, or in inadequately treated gonorrhoea, as with small infrequent doses of a sulfonamide. The urethral discharge of chronic anterior folliculitis or prostatitis is loaded with mixed organisms, and urethral smears show myriads of secondary organisms, usually small gram-negative bacilli. Such a picture never occurs in the urethral discharge associated with the prostatitis under consideration.

Evidence seems to indicate that the prostatitis in the present series is a true infection due to the invasion of the gland by the gonococci or other organisms or both. However such a conclusion fails to answer certain important questions:

1. Why the initially simultaneous development of anterior and posterior urethritis in some cases of acute gonorrhoea?
2. Why do a few gonococci survive penicillin, invade the prostate, and not the anterior urethra?
3. Why is the gonococcus so difficult to recover in cases of this kind? PETER L. SCARDON, M.D.

Some Aspects of the Surgical Pathology of the Testis. NORMAN WYNDHAM. *Austral N Zealand J Surg* 1947 17 47

The author outlines the embryological and anatomical steps of testicular descent. The gonad develops particularly from the caudal aspect of the intermediate cell mass low in the abdomen where it remains with little variation until migration to the scrotum occurs. From the anterolateral aspect of the intermediate cell mass the Wolffian duct develops. The latter becomes involved in the tail fold and therefore lies close to the cloaca with which it fuses in its posteromedial aspect. The Wolffian duct is connected to the groin by a fold of peritoneum, the gubernaculum, in which subsequently develops the gubernaculum. The latter lies near the developing testis, becoming attached to various areas but not to the gonad. It joins the structures of the cord at the junction of the vas deferens and epididymis. Muscular and vascular development actively proceeds and pushes the testis somewhat cephalically. Many fantastic theories have been proposed to explain testicular descent, yet little is known of the mechanisms involved. The gubernaculum could hardly pull by muscular contraction since either attachment is rigid. Apparently descent occurs quite rapidly during the seventh month without evidence of intermediate stages. It is interesting that one fails to find evidence of tension on the structures cephalic to the testes immediately following descent. Also, one notes a disappearance of the gubernaculum which would suggest that by shortening the testis would be pulled down, but this could only occur if the cephalic testicular attachments lengthened simultaneously. For this there is no good evidence. The stimulus to descent is derived from the pituitary gland acting on the testis itself.

There has been no entirely satisfactory explanation for the descent of the testis to the vulnerable scrotum. The phenomenon occurs in some, but not all, mammals. Testes destined to descend and which fail to do so do not develop normally. Imperfect development of the seminiferous tubules occurs with spermatogenesis arrested at the spermatid stage or earlier otherwise, however the misplaced testis functions normally. It has been stated that malignancy occurs more frequently in the testis which has not descended.

While the incidence of cryptorchidism is estimated to be about 2 per cent, a suggested figure for the occurrence of malignancy in undescended testes is 3.2 per cent. The author states that the majority of undescended testes will descend normally unaided but that the bilateral ones do not descend without assistance. While malignancy is known to develop in testes which have been transplanted to the scrotum the author condemns abdominal transplantation since tumors in such testes are difficult to diagnose.

Gonadotropic hormone of the pituitary is necessary for testicular development. However, the use of hormonal therapy in cryptorchidism has been disappointing. The author suggests the use of the hormone of pregnancy urine as an adjunct to surgery with the institution of therapy several weeks prior to orchidopexy.

The interstitial cells (Leydig) are said to produce androgens. However many conflicting observations have been reported and there exists no uniformity of opinion to explain the bizarre pictures observed in patients with testicular atrophy or tumors of the interstitial cells. Certain facts are fairly well established. The benign embryoma of the testis is not associated with any abnormal hormone production. While seminomas produce no hormone of their own by compression of the surrounding testis with atrophy of the interstitial tissue the pituitary gland produces sufficient follicularizing hormone to give an Ascheim Zondek reaction with a decreased androgen production. On the other hand adenocarcinoma and chorioepithelioma elaborate a lutenizing hormone.

The author observed 25 testicular tumors with an equal number of seminomas and teratomas but no interstitial cell tumors or adult embryomas. From his study he concluded that the prognosis depended on the inherent malignancy of the tumor and not on the length of preoperative history. Teratomas were not radiosensitive. While only 1 of 14 patients with seminomas were dead at the time of the present report 5 of 11 patients with teratomas were dead. Seminomas occur somewhat later in life than teratomas are radiosensitive do not elaborate hormones and the prognosis is better. Seminomas are said to be growths of the seminiferous tubules.

PETER L. SCARDINO M D

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Two Cases of Lipomatosis Involving Bone. S. F. OOSTHUIZEN and JAMES BARNETSON *Brit. J. Radiol.* 947 30 436.

Two cases of monstrous enlargement of the right foot in adults which existed since birth, were thoroughly studied by means of roentgenograms at the dissecting table, and by microscopic section after amputation of the involved extremity.

In both cases the primary changes appeared to have been marked infiltration and replacement of bone and soft tissue by "adult type" adipose tissue. There was also marked enlargement and distortion of the bones, and most of the joints of the involved areas were obliterated by bony ankylosis. There was, in one case, cross union between the phalanges. Round cell infiltration and great thickening of the small arteries were noted in both cases.

The etiology is unknown, but the authors regard the condition as a congenital disturbance of adipose tissue formation. NEWTON C. MEAD, M.D.

Cellular Mutability and Malignant Change of Cartilage Cells in Chondrodysostrophies (Instabilité cellulaire et déchéances de la cellule cartilagineuse des chondrodysostrophies) A. COMARACCO. *Lyon chir.* 947 4 48

The cartilaginous foci in Ollier's dyschondroplasia may ossify or remain indefinitely unchanged. The author discusses the possibility of malignant degeneration of these congenital cartilage cells. A possible slow malignant degeneration of large chondromas has been well known.

The exostoses found in Ollier's dyschondroplasia tend to ossify when the individual ceases to grow. Cases have been reported in the literature in which

exostoses have degenerated into malignant tumors. Most likely there was not a true cellular metastasis of bone cells into cartilage cells but an abnormal development of the enclosed cartilage cells into the exostoses. Ollier's dyschondroplasia has a tendency to ossify at termination of growth but there is no definite proof that the foci of cartilage cells invariably calcify. The ultimate fate of these cartilage enclosures is not known and the author presents a case of unilateral multiple enchondromas of the type of Ollier's dyschondroplasia which showed monstrous changes in several foci at the same time. The patient was a 12 year old boy who was admitted to the hospital with the complaint that several tumors had formed concomitantly in three different areas of the right arm. One tumor mass developed around the right elbow, one around the right shoulder and the third around the right wrist joint. There was local heat, pain and limitation of motion in the affected joints. Physical examination at time of admission showed discrete, hard, painful globular masses in the right shoulder involving the shoulder block the elbow and the distal third of the lower arm. The severity of the pain rendered the right arm useless. There was slight elevation of temperature (from 37.1 to 38.5 C.), severe anemia (0 million rbc) leukocytosis (12,200) and a normal white differential count. The roentgenogram of the forearm showed large well outlined cartilaginous masses in the central portion of the bones but with destruction of the cortex and invasion of the soft tissues at the periphery. The elbow joint also was partially destroyed by these masses. In the region of the shoulder the tumor mass had destroyed the joint completely and invaded the scapula. The distal end of the radius did not show as much destruction. The chondromatous masses were well localized in the cancellous portion of the bone. The periosteum was elevated along the entire diaphysis. The epiphysis was not disturbed. Biopsy of the tumors of the shoulder and elbow revealed small, well circumscribed cells with hyperchromatic, irregular nuclei within the marrow cavity. In certain areas the cells strongly resembled the picture of a spindle cell sarcoma. Giant cells were noticed especially around blood vessels. Biopsy of the regional lymph nodes revealed replacement of normal glandular tissue by fusiform cells with irregular dense, often monstrous, nuclei. The patient refused further treatment and did not return.

The question is raised whether one should consider this case as a true dysostrophy or whether one should assume that these tumors were malignant to begin with. The multiplicity of the lesions, their distribution and the age of the patient leave no doubt that this case originally was a dysostrophy. The malignant change in several foci at the same time points to a high degree of mutability of the cartilage cells in cases of chondrodysostrophy. Another proof of the

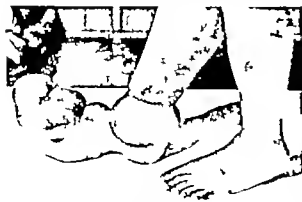


Fig. (Oosthuizen and Barnettson) The gross appearance of the foot in comparison with its fellow

considerable mutability of cartilage cells is found in cases of sarcomatous changes in Paget's osteitis deformans. In these of course, the change occurs slowly as a rule. Considering the mutability of cartilage cells in dystrophies, one is not surprised to hear of a case of enchondromas of the fingers which underwent malignant changes, metastasized and killed the patient within 2 months.

GEORGE I. REIMS, M.D.

The Cut Flexor Tendon J. B. KIMMORSE, *Brit J Surg* 1947 35 29

In this review of 31 repairs of flexor tendons in the hand the author states that he makes free use of the free graft and follows the teaching of Bunnell in the use of stainless steel wire which is removed sometime after the third postoperative week. He advises for this surgery a bloodless operative field, physiological skin incisions and extremely gentle handling of the tissues.

In the procedure to be followed primary suture should rarely be used and it never should be used when the tendon is severed within a sheath.

The majority of cut flexors should be dealt with by elective procedures after the wound has healed which in uncomplicated cases is usually about 3 weeks after injury.

A free graft of the palmaris longus tendon if this is available, is favored for all cases in which division has occurred within the sheath and both flexor tendons are removed from the tunnel even though the sublimis tendon is not injured. The proximal end of the graft extends to the middle of the palm so that the anastomosis will not be within the sheath. The distal end is attached to the distal phalanx.

A graft is not necessary when the severance has occurred so far distally that the tendon can be reattached to the distal phalanx without undue tension or when the division is in the midpalm and not within the tunnel.

Success is unlikely if there is pre-existing joint stiffness, or if the patient is aged. Unco-operative or unintelligent patients are not good subjects for this surgery as the postoperative care cannot be well carried out.

The technique of the operation is well described but it differs in no important way from the description of Bunnell. The stainless steel fixation stitch is removed in 3 weeks but active and passive motion of the fingers is not begun until 6 weeks postoperatively.

Of the 31 repairs described only 4 failed to give a result good enough for normal use and so that the patient could return to preaccident work. The author believes that 3 of these failures could have been avoided in the light of his present experience.

NEWTON C. MEAD, M.D.

Synovitis of the Wrist. THOMAS W. STEVENSON *Plast Reconstr Surg* 1947 3 443.

The gross anatomy of the tendons and sheaths about the wrist is reviewed briefly and the current

methods of treating synovitis are briefly discussed by the author.

Swelling and irritation of the synovial sheaths may be entirely mechanical and may be acute (due to unusual forceful use) or chronic (due to long repeated trauma). In the chronic condition a moderate effusion may persist and this may be accompanied by progressive thickening congestion and corrugation of the synovia. Sometimes villi are numerous and the lining of the sheath is reddish purple in color. The tendon itself may be enlarged and separated into several bundles with pale edematous almost cystic protruding masses. The tendon may even separate under continued stress. An illustrative case of this condition is presented. Cure was obtained by synovectomy.

Tuberculous tenosynovitis is discussed and the author presents 5 cases. The similarity of the chronic traumatic disease to tuberculous tenosynovitis, both in appearance and in the history obtained is mentioned. Synovectomy was carried out successfully and in one case resection of a metacarpophalangeal joint was done with good result.

An interesting case of a large lipoma located beneath the flexor tendons in the palm is shown. Such a lesion may simulate synovitis with effusion.

No controversial points are brought up in this article and no new methods are presented. It is well illustrated with good photographs.

NEWTON C. MEAD, M.D.

Posterior Displacement of Lumbar Vertebrae ABRAHAM MELAMED and DAVID J. ANFIELD *Am J Roentg* 1947 58 307

Posterior displacement of a lumbar vertebra sometimes referred to as reverse spondylolisthesis or spondylolisthesis posterior consists of backward displacement of the cephalad vertebra in relation to the adjacent caudad vertebra. The purposes of this study were (1) to ascertain whether or not the condition of posterior displacement of the fifth lumbar vertebra on the sacrum actually exists and if it does what anatomical factors are important for consideration (2) to determine what factors (anatomical, pathological, and/or technical) influence the roentgen appearance of the lumbar vertebrae and sacrum and (3) to determine the roentgen criteria of true posterior displacement of lumbar vertebrae.

A review of the available literature reveals divergent opinions as to the existence of posterior displacement of the lumbar vertebrae and explanations for the varied beliefs.

Specific anatomy of the lumbosacral spine is discussed. Attention is called to the fact that in the upper lumbar region the stress is downward and backward while in the lower lumbar region the stress is downward and forward. Usually the body of the fifth lumbar vertebra exhibits flaring or skirting at the posteroinferior margin. Slight rotation of the spine is found to exaggerate the actual extent of this condition.



Fig. 1. (Afekamed, Ansfield) Patient aged 60. a. Upright lateral roentgenogram in flexion shows posterior displacement of first lumbar vertebra on the second lumbar vertebra. Note marked narrowing of intervertebral space, verti-



cal and anteroposterior narrowing of the intervertebral foramina resulting in "hourglass" deformity of these structures, and overlapping of articular processes. b. In hyperextension there is increased retrodisplacement.



Fig. 2. Patient aged 50. Lateral roentgenogram reveals posterior displacement of fourth lumbar vertebra on the fifth. Reactive changes are quite marked and the intervertebral foramina show typical "hourglass" appearance. Widening of apophyseal joints (facets of anteroposterior type) well demonstrated (arrows).

True backward displacement of the lumbar vertebrae may be due to degenerative processes, disease, trauma, or congenital anomalies. Apparent backward displacement may be due to technical factors or to anatomical variations. The authors believe that intervertebral disc degeneration is the most common cause of the finding. This degeneration results in instability and relaxation of the longitudinal ligaments and secondary stretching of the capsules of the apophyseal joints.

Retrodisplacement occurs more frequently in the upper lumbar region than in the lower lumbar region because the upper half of the lumbar spine inclines backward in relation to the center of gravity. An important sign in roentgenography is designated as the "hourglass" appearance of the intervertebral foramina. This is noted on the lateral projection and is caused by a reduction in the distance between the posteroinferior border of the cephalad vertebra and the anterior border of the superior articular process of the caudad vertebra.

Displacements secondary to trauma, disease, and congenital anomalies are apparently much less frequent than those due to degeneration.

Apparent backward displacement of the lumbar vertebrae is relatively frequent according to the authors. This factor has led many critical observers to refute the possibility of actual retrodisplacement. Technical factors which can lead to errors in interpretation are faulty positioning of the patient on the roentgen table by disregard of the factors of rotation and sagging of the lumbar spine, incorrect alignment of the central ray to the structures in question, and



Fig. 3. (McLeland, Anfield) a Patient aged 19, student nurse. The transverse diameter of the pelvis measured 34 cm. while the transverse diameter at the waistline measured 36 cm. Lateral roentgenogram taken with hips elevated off table top for approximately 9 cm. in order to produce slight sagging in lower lumbar region. Note apparent narrowing of the lumbosacral joint and apparent posterior displacement of fifth lumbar vertebra. b Lateral roentgenogram of same patient, the hips no longer elevated and sagging eliminated, with central ray aimed at the lumbosacral junction. Neither retrodisplacement nor apparent narrowing of disc is observed.

short target-to-film distance. Anatomical and pathological factors which can account for apparent backward displacement are discrepancies between the midsagittal diameters of the fifth lumbar and first sacral segments flaring or skirting of the posteroinferior border of the fifth or last lumbar vertebra by peritrophic flapping of the posteroinferior margin of the cephalad vertebral body tapering of the vertebral bodies and sacralization of the last lumbar vertebra and beveled posterosuperior sacral margin.

Extensive studies are reported and illustrated showing varying roentgen appearances of anatomical specimens. In addition, careful evaluations have been made and demonstrated regarding clinical applications of these findings.

Criteria for the roentgen diagnosis of retrodisplacement of the lumbar vertebrae are elaborated in the article. They are as follows:

- 1 Degeneration of the intervertebral disc, with or without actual narrowing of the interspace (this is essential)
- 2 The posterior border as well as the anterior border of the cephalad vertebral body must be displaced posterior to the corresponding portion of the caudad vertebra

- 3 Narrowing of the intervertebral foramina—at least in the anteroposterior direction

- 4 Displacement of the facets and/or widening of the apophyseal joint space (this is believed to be essential)

- 5 Prominence or protrusion of the spinous process of the displaced vertebra on the sagittal projection

- 6 Alteration of the lumbar curve.

- 7 Roentgen signs of retrodisplacement not eliminated by technical means.

KENNETH H. SPONSTL, M.D.

Subcutaneous Tear of the Achilles Tendon. Diagnosis and Therapeutic Results (Subkutane Ruptur der Achillessehne. Diagnostik und Behandlungsergebnisse). OREHAM TOYOVAR. *Helvet. chir. acta* 1947 14, 209.

The clinical signs of subcutaneous tear of the Achilles tendon were first described by Ambrose Paré and Petit in 1772. It is a rare condition and therefore has been given very little attention in the medical literature. In a large European clinic only 17 cases were observed within a period of 20 years during which time 237 174 patients were treated.

This condition occurs quite frequently as an occupational disease in dancers, acrobats, and clowns. It is known in England under the name of "tennis leg" or "calf sprain." It occurs most frequently in men between the ages of 25 and 53. The lesion is usually unilateral. Familial occurrence was observed only once when a man sustained a tear of the Achilles tendon while playing handball and his sister sustained a similar injury a year later.

There is usually sharp pain in the region of the Achilles tendon as if it were struck by a whip (coup de fouet). After the lapse of a few days the pain is either localized further distally over the os calcis or further proximally over the musculotendinous junction of the calf muscles. The patients are unable to stand on their toes or lift their foot off the ground. Walking is difficult and associated with severe pain. Walking down stairs is especially difficult because of the unopposed action of the anterior leg muscles which tend to dorsiflex the foot.

The physical findings are characteristic. There is a depression of the skin covering the torn Achilles tendon when viewed from the side. The heel seems to be larger as compared with the normal side. In cases of incomplete tear there is a thinning of the tendon. Immediately following the injury there is a considerable hematoma due to the excellent blood supply in this region. In older cases there is atrophy of the calf muscles. This persists if patients are operated on at a late date. In some cases palpation with the fingers will reveal the gap in the tendon or the complete severance of the usually finger thick structure. By moving the foot up and down a tear in the Achilles tendon can be easily palpated. Usually a diagnosis can be made by means of a lateral roentgenogram taken with soft tissue technique. There is a depression of the soft tissue shadow of the tendon. Normally a triangle is seen on the roentgenogram, which is formed by the Achilles tendon, the calcaneus and the flexor digitorum longus, the flexor hallucis longus, and the peroneus brevis and longus. In case of a tear of the Achilles tendon this triangle is smaller and occasionally completely absent.

The tear usually occurs from 3 to 4 cm. proximal to the insertion of the tendon into the calcaneus, the tendon being narrowest at this level. There were 2 cases in which the tendon ruptured at two points.

Several conditions must be taken into consideration in the diagnosis of simple tear of the Achilles tendon such as fractures, sprains, and dislocations in the region of the ankle joint. Often the Achilles tendon tear is misdiagnosed as stenosing tenosynovitis, peritendinitis, achillobodynia, traumatic tendinitis, or rheumatism.

It is believed that prior to the tear some type of degeneration has to take place within the tendon. This is difficult to evaluate because by the time the patients are treated operatively it is not easy to differentiate degenerative and regenerative processes. It is impossible to state to what degree age infectious diseases or metabolic disorders may cause a

rupture of the Achilles tendon. It is quite likely that the mechanism of the Achilles tendon tear can be compared with that of patellar fracture, and that other conditions, such as syphilis, malaria, gout and gonorrhea represent only coincidental findings.

Conservative symptomatic treatment of the condition is not satisfactory and should be used only in cases of partial tear of the Achilles tendon at the musculotendinous junction. The patients suffer discomfort and are unable to walk without a limp for months and sometimes years after conservative treatment.

The sooner after the injury that operative treatment can be carried out the better the results. With the patient in the prone position the Achilles tendon is exposed and approximated with the help of 3 to 5 strands of braided silk sutures. In older cases it is often difficult to pull downward the proximal portion which has retracted upward for quite a distance. If approximation cannot be accomplished by the usual methods the following procedures may be employed:

1. The tendon ends are approximated as far as possible with silk sutures and the gap is filled in with connective tissue which ultimately replaces the missing tendon piece satisfactorily.

2. A portion of the contralateral fascia lata is excised, rolled into a tube and sutured in such a way as to surround the torn ends of the tendon. The fascial transplant eventually assumes all the appearances of a true Achilles tendon.

3. A portion of the gastrocnemius fascia is folded distally. Its distal end being left attached and its proximal end is sutured inside out to the calcaneus. The results of this procedure have not been entirely satisfactory as there is a persistent weakness in the calf muscles.

4. Toygar performs a bilateral tenoplastic operation by sliding a small portion of the tendon down or up respectively, to the gap and suturing it. The foot and lower leg is immobilized in a slight equinovarus position for 14 days. The plaster cast is then changed and the foot flexed to a right angle. Immobilization is continued for from 4 to 6 weeks, after which time physical therapy is given. The results have been uniformly satisfactory. Sixteen patients were treated operatively following the outlined procedure and were able to run without difficulty from 23 to 63 days postoperatively.

GRODZ L. REZES, M.D.

ORTHOPEDICS IN GENERAL

A Universal Splint for Immobilization of the Hand in the Position of Function. HARTY S. AILEY and MICHAEL L. MAROX. *Q. Bull. Northwest. Univ. Med. School* 1947 21 18.

The restoration of function is the main purpose of the universal splint described by the authors. The splint was devised during the latter phase of the Italian campaign. It is applicable in about 90 per

SURGERY OF THE BONES JOINTS MUSCLES TENDONS

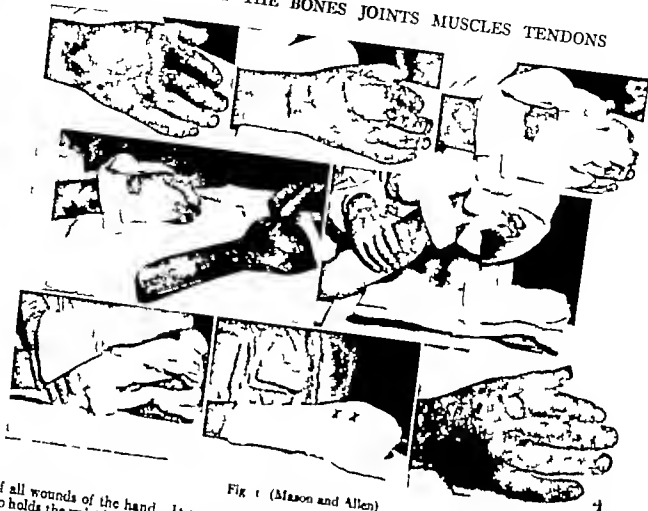


Fig 1 (Mason and Allen)

cent of all wounds of the hand. It is made so that the cup holds the wrist in dorsiflexion and about the cup the fingers and thumb fall naturally into the grasping position. As the hand is laid on the splint and molded accurately to its surface fractures of the present, are reduced in the process by gentle pull on a strip of 2 inch adhesive tape. This splint is also useful in compression treatment of burns of the hand.

Most fractures of the metacarpals and phalanges may be reduced successfully by molding the hand over the splint and applying the compression dressing.

Oblique fractures through the proximal phalanges of the digits are treated successfully. The splint may be used for either the right or left hand and for maintaining the hand in the position of function in a wide variety of conditions. This splint is made up in 2 or 3 sizes and will meet the requirements of splinting in approximately 90 per cent of the cases.

RICHARD J. BENNETT JR. M.D.
The Walking Caliper JOHN CHARNLEY *Lancet* Lond.
1947 2 464

The art of making and fitting braces tends to be neglected by the younger generation of orthopedic surgeons. The commercial splintmaker perpetuates traditional types since he often lacks adequate professional guidance. The author made a study of the

walking caliper brace and developed a modification of the original type invented by H.O. Thomas. This modification was utilized as an easily fitted brace for use in the British army.

The fundamental principles for construction and use of the splint as invented by H.O. Thomas have been modified. Study of the literature and examination of a walking caliper brace originally fitted by Thomas have led to the following conclusions.

The authentic Thomas splints were of two types. The adapted bed splint was made from a bed splint by cutting off its end and inserting the splint into the heel of the boot. The ring was a simple ovoid the side bars were attached at opposite ends of the transverse diameter. The splint was thus symmetrical and reversible.

The Thomas caliper was described by the American surgeon John Ridlon in 1893 as follows. The ring is an irregular ovoid flattened in front, and drawn out at the posterior and inner portions. The ring slopes from without inward and from before backwards in such a way that the point upon which rests the tuber ischii is the lowest part of the ring.

In the caliper examined which was over 50 years old the side bars were in front of the transverse diameter the ring was flat in front, and the lowest part of the ring was posterior. With the side bars anterior in relation to the ring the bars roughly parallel the anatomical position of the femur.

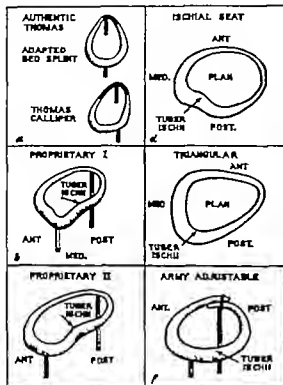


Fig. 1. Ring of Thomas caliper and modifications thereof.

Proprietary rings are made with indentations or protrusions at the ischium in order to maintain position and weight bearing on the tuber. In practice this does not work out. The ring adjusts itself so that the lowest portion is under the tuber ischii. This gives rotation of the limb and/or pain. Indentations at the tuber ischii gives rise to displacement of the ring on contraction of the hamstring muscles. The author believes that the tuber ischii takes only a fraction of the body weight. A large part of the weight is efficiently taken on the ring through the fibrofatty fold of the buttock and the lower border of the gluteus maximus when in contraction.

Rings deviating from the Thomas type are the block leather ischial seat and ring, and partial rings. The block leather ring is a molded leather corset like that of an amputation prosthesis. It is dead, but is expensive and difficult to manufacture. The half ring is considered to be inferior in weight relieving

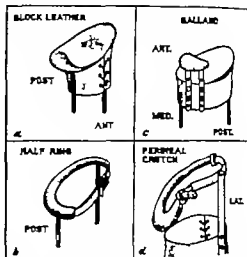


Fig. 2. Rings which deviate from Thomas pattern.

function, but is useful in paralytic cases. The author believes that the soft-front ring tends to encourage flexion of the hip and permits the ring to slip off the weight bearing surface posteriorly.

With all factors considered, the author designed the British Army adjustable caliper. Its purpose was to fulfill a need for a low cost, easily fitted, rigid type of brace for large numbers of patients. The ring is a simple ovoid and the essential feature is that the circumference can be adjusted to fit the root of the limb. The ring should be just snug enough to take some effort to pull to the root of the limb but should not be tight enough to constrict. Another factor the author finds advantageous is the placing of the side bars slightly behind the center of the ovoid ring for more direct lines of stress. An angle of about 30 degrees with the horizontal plane gives a good angle of inclination from the outer high side to the inner bar. The ring is best placed horizontally in the anteroposterior plane. The insertion of the caliper into the boot may vary anteriorly or posteriorly to the ankle joint axis. A stiff ankle brace is of the utmost importance in splinting delayed union of bones of the leg. Comfort may be obtained by raising the heel of the shoe on the normal side. Patients complaining of intolerable pain in the groin in the region of the adductor tendons will usually be found walking with the trunk sloping forward and with the hip in slight flexion.

KENNETH H. SPENCER, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

The Necessity of Immediate Intervention in Phlebitis of the Inferior Vena Cava: a Case of Segmental Resection of the Vena Cava (Nécessité de l'intervention immédiate dans les phlébitides de la veine cave inférieure. Un cas de résection segmentaire de la veine cave) R. LERICHE, *Lyon chir* 1947 42 385.

In massive iliofemoral thrombophlebitis the thrombosis may extend into the vena cava despite symptomatic block and the use of heparin. Both lower extremities become swollen and the edema extends to the abdominal wall and lumbar region. Actually, the opposite iliac vein does not become thrombosed at first, despite the severe venous stasis. The author found undoubted liquid blood in the femoral vein 20 days after it had become obstructed by a thrombosis of the vena cava originating from the opposite side.

On the basis of 4 operative cases the author believes that vena cava thrombosis is probably always secondary to a thrombophlebitis of the iliofemoral system and is not primary in the vena cava itself.

Along with the inflammatory reaction in the veins there is a similar reaction in the vasa vasorum of the arteries which accompany the veins as well as a severe lymphangitis and lymphadenitis. In the chronic stage there is a marked perivascular fibrosis. Much of the edema in phlebitis may be attributed to lymph stasis.

The development of a collateral circulation begins promptly in these cases. The retroperitoneal veins are even more important as collateral channels than the veins visible on the abdomen. One case is cited in which one ovarian vein was as large as a loop of intestine. Despite the rich collateral circulation the patient with thrombosis of the vena cava becomes an invalid because of the pain, heaviness and swelling which occurred in the upright position.

The author reports a case of secondary thrombosis of the vena cava which arose from a postpartum left femoral thrombophlebitis. He operated on the twentieth day after the onset hoping to perform a thrombectomy of the vena cava. Because the thrombus was densely adherent, removal was not feasible; hence a segment of vena cava was resected between ligatures. Relief of symptoms occurred promptly after operation. Four months later the patient was almost completely free of the usual sequelae of vena cava thrombosis.

THEODORE B. MAMMILL, M.D.

Primary Septic Thrombophlebitis of the Inferior Vena Cava (Trombose séptica primitiva da veia inferior) A. MARQUES TORRES and NEIR A. MIRANDA. *Rev. Brasil med.*, 1947 4, 680.

When the authors first saw their patient, a man of 28 years, they thought that he had a syndrome of lumbosacral radiculitis involving L5, S1, and S2 with typical sciatica, which had started about a

month previously. The findings consisted of severe piercing paroxysmal superficial and deep pains which occurred spontaneously or were caused by movements of the spine or the extremities; pains which originated deeply in the abdomen and radiated around the trunk or along the extremities; nearly always bilaterally paresthesias which persisted during the recessions of pain; hyperesthesia of the lower third of the external aspect of the left leg; anesthesia and thermoanalgesia of the left foot; paresis of the left lower extremity with slight amyotrophy of the thigh; tendon reflexes first increased and then nearly abolished; trophic disturbances (edema, cyanosis); absence of sphincter disturbances; and spinal fluid with albumin at the threshold of normal (0.30 per cent) but without changes.

Because of the character of the persistent pains the second possibility considered was pelvic thrombophlebitis. Pott's disease, vertebral cancer, sacralization of the fifth lumbar vertebra, spondylosis and spondylitis, pachymeningitis, meningeal tumor, inflammation of the psoas muscle, and abscess of the iliac fossa were definitely excluded.

However 12 days after admission collateral circulation of the inferior vena cava type began to develop gradually without ascites and with slight edema of the abdominal wall. Edema was already marked in the extremities. A diagnosis of primary septic thrombophlebitis of the inferior vena cava was made. It was thought that it might have been due to infection of the genital organs as the patient had had gonorrhea with marked urethral stricture. The disease had probably developed as follows: genital infection of the urethra and prostate, pelvic cellulitis, involvement of the roots of L5, S1, and S2 by the inflammatory process and septic perithrombophlebitis of the inferior vena cava which, with progressive increase of the thrombus, culminated in the syndrome of portal hypertension. The patient died 9 days later and autopsy confirmed the diagnosis.

The authors call attention to the importance of gradual and unaccountable acceleration of the pulse for the diagnosis of inflammatory involvement of the venous system and to the fact that usually the disease begins with a small pulmonary embolism as occurred in the present case 3 days before the onset of the severe symptoms. Penicillin, sulfathiazole, sodium salicylate, iodide, and various analgesics were used in this case without results.

RICHARD KEMEL, M.D.

Experiences with Pulsating Hematoma W. C. BECK. *Am J Surg* 1947 73 580.

The author suggests that there has been a slight increase in the incidence of pulsating hematomas in World War II over that in World War I. This increase applies both to the actual incidence and the relative incidence as compared with arteriovenous fis-

tula. In the last war there was apparently about 1 pulsating hematoma to every 500 battle casualties. In all of the cases seen by the author there was partial transection of an artery which prevented the natural hemostatic sequelae of arterial transection from exerting their action i. e. retraction of the vessel with rolling up of the arterial intima.

In most instances there was however an attempt of the natural forces to stem the flow of blood usually by the interposition of a muscle plug. Then, when the extremity again was used and the blood pressure had regained its pretrauma level a secondary hemorrhage either into the tissues or through the original wound tract ensued. Thus most of the symptomatology was delayed for from 1 to 3 weeks, or longer following the original wound. Then secondary hemorrhage played an outstanding role. The differential diagnosis was generally not difficult if the lesion was kept in mind. The most important differentiation was from abscess because of the danger of an indiscriminate incision. This could easily be made with the stethoscope.

The more difficult differential diagnosis lay between pulsating hematoma and an arteriovenous fistula with a false aneurismal sac. The latter could be told by the to-and fro murmur and by the positive Brannham phenomenon.

There is little choice in the treatment. Of 24 cases observed as a result of battle wounds only 1 was observed to end in a spontaneous cure. In all of the others, an operative intervention became imperative, usually as an emergency procedure. A tourniquet was used whenever possible, and if this could not be done because of the position of the lesion, a provisional ligation of the vessel was done proximally. The approach to the vessel was found to be best through the classical approaches rather than through the presenting parts of the mass. A double ligation was necessary in each case and in none could any form of reparative surgery be performed upon the vessel.

Postoperative care was found to be most important in the care of the ischemic limb. Cooling of the extremity, as well as sympathetic denervation were found to be helpful. Of greatest importance, however was the replacement of lost blood through repeated and massive blood transfusion so that the

oxygen capacity of the blood was maintained at its maximum.

WILLIAM C. BECK, M.D.

LYMPH GLANDS AND LYMPHATIC VESSELS

Lymph Leakage (Lymphorrhoea). F. C. FRANKLIN. *Surgery* 947 22 834.

The author reports 3 cases of lymph drainage from the site of operation following saphenous ligation.

It is amazing that lymph leakage should be so unusual a complication in view of the frequency of saphenous vein ligation, the propinquity of the subinguinal lymphatics and nodes to the saphenofemoral junction and the slow clotting of peripheral lymph.

The subinguinal nodes and superficial lymphatics coursing along the saphenous vein are those most likely to be torn in the dissection of the saphenofemoral junction. They are small, friable and lack the protective coloring of veins. Injury during operation is therefore usually unrecognized. Lymph flows more slowly than blood is lower in protein content and its viscosity is less than that of blood.

Howell has shown that delayed clotting is due to thromboplastic material. In the blood, this substance is contributed chiefly by the platelets and, to a minor degree by the leucocytes. In lymph, platelets are lacking and white cells are poor sources of thromboplastin. Howell also stated that lymph contained a relative excess of antithrombin. The delay in the clotting of lymph may be due to the low viscosity, lower protein content, lower fibrinogen content, lack of thromboplastin, excess of antithrombin, or more likely a combination of these factors.

In cases associated with phlebitis there is a great augmented flow of lymph which would tend to make this condition more persistent.

There are several effective means of treatment. The application of an elastic pressure bandage from the foot to above the incision with the elevation of the leg will invariably stop leakage within a short time due to the forcible collapse of the lymphatics. If the wound is laid open or disrupts, firm packing is advised. The local application of a thromboplastic substance is recommended as well. Drinker has suggested crushing the subcutaneous tissues with a hemostat to release an excess tissue extract rich in thromboplastic material. EDWARD R. DOWDNEY, M.D.

SURGICAL TECHNIQUE

OPERATIVE SURGERY AND TECHNIQUE POSTOPERATIVE TREATMENT

The Value of Postoperative Dicoumarin Prophylaxis at Early Rising. SIO BORGSTRÖM. *Acta chir scand* 1947 96 47

Recent statistics indicate that both early postoperative ambulation and postoperative dicoumarin therapy decrease the incidence of postoperative thromboembolic complications by about one third. The question then arises as to whether a combination of the two forms of therapy will effect a further reduction in thromboembolic complications.

In an effort to answer this question all surgical patients over 25 years of age who were admitted to the Surgical Clinic in Lund during the year 1946 were divided alternately into two series. Patients in both series were allowed early postoperative ambulation and in addition the patients in one series were treated prophylactically with dicoumarin while those in the other series were used as controls. In approximately 17 per cent of the patients scheduled to have dicoumarin therapy, the surgeon believed it to be contraindicated and it was withheld. The author exhaustively demonstrates that the two series were comparable as to the average age of the patients, the duration of the time of stay in bed after operation, the body weight and the various types of operative measures carried out.

Dicoumarin therapy was started the day after operation when a dose of 0.25 to 0.125 gm was given. Further dosages were governed by the fall in prothrombin time which was kept between 60 to 40 per cent of normal. If bleeding occurred, or the prothrombin time fell below 40 per cent, vitamin K was given in amounts ranging from 0.5 mgm to 20 mgm. In the dicoumarin treated cases all postoperative bleeding was considered as due to the therapy, no fatal bleeding or any bleeding difficult to control resulted, and a percentage increase of bleeding in the dicoumarin treated patients of only 1.1 per cent resulted. The author thus concludes that properly controlled dicoumarin therapy is a safe procedure.

Upon analyzing the results the author found that among men no statistically significant decrease in thromboembolic complications was observed between the dicoumarin treated individuals and those in the control series. However in women there was a statistically significant decrease (of 4.4 per cent) in the incidence of these complications among the dicoumarin treated patients. Also no fatal pulmonary embolism occurred among the prophylactically treated patients, while 7 such deaths occurred among those not receiving this therapy.

The author thus concludes that combining dicoumarin prophylaxis with early ambulation does not decrease the incidence of thromboembolic compli-

cations in men but the incidence of such complications in women is definitely decreased.

F J LESEMAN JR. M.D.

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Essential Therapeutic Adjuncts in the Surgical Arrest of Wolff Israel Actinomycosis. MIMS GAGE, CHAMP LYONS, and PAUL T. DECAMP. *Ann Surg* 1947 126 368.

At the present time the management of serious actinomycotic infections has emphasized (1) antibacterial therapy, (2) high dietary intake of protein with adequate calories and (3) drainage of pus and surgical excision of tissue devitalized by infection. The authors add a fourth feature—transfusion of whole blood in quantities sufficient to restore the total circulating red blood cell mass to or slightly below the standard for the patient's standard or usual weight in health.

Most of the patients require radical surgical eradication of their disease. A poor tolerance for blood loss and surgical trauma has been encountered in these chronically ill patients.

Five patients with Wolff Israel actinomycosis presented themselves while the authors were making studies on hemoglobin deficiency in chronic shock and on the problems of reduced blood volume in the chronically ill patient. Observations of the quantity of blood necessary to overcome the anemia in patients with actinomycosis revealed an unexpectedly great deficit in the total circulating mass of red blood cells. The improved tolerance for surgical blood loss and the acceleration of wound healing noted after blood volume restoration were especially striking. Weight gain and convalescence were rapid in the patients with adequate dietary intake.

Secondary anemia and deficiency of body weight were characteristic features of this chronic illness. Laboratory estimations of the hemoglobin deficit were not too reliable when the hemoglobin concentration or hematocrit percentage was ascertained. The quantity of blood necessary to restore the hematocrit to the range of normal was in excess of that predictable on the basis of the initial hematocrit value.

The true deficiency of circulating red blood cells was more accurately revealed by blood volume determinations than any other available method. These measurements were performed by the plasma dye hematocrit method and standard values were calculated on the basis of the patient's usual weight in health. The results confirmed the existence of "chronic shock," the reduced blood volume being associated with weight loss (as described by Lyons *et al*).

The program of management of these cases was essentially (1) hospitalization (2) administration of

from 25,000 to 50,000 units of penicillin every 3 hours, (3) correction of anemia with blood transfusion to the point where the patient could tolerate surgical blood loss, (4) gain in weight, (5) surgery, (6) postoperative transfusions to prevent recurrence of "chronic shock" and loss of weight, and (7) administration of sulfa drugs for a prolonged period throughout the convalescence. Sulfonamides were not used preoperatively because of the depression of hematopoiesis, appetite, and synthesis of essential metabolites produced by the sulfa drug. Kidney complications were also deterrents in the use of these drugs while the patient was critically ill.

The authors' detection and correction of chronic shock in the treatment of actinomycosis have resulted in excellent results in the cases reported.

LUDWIG R. DOMOGUZZI, M.D.

Chemotherapy in Surgery. W. A. ALTMEIER, J. Missouri M. Assn. 947 44 803

Clinical experience has proved that for systemic administration, sulfadiazine is the least toxic of the sulfa drugs and the sulfonamide of choice in surgical infections. Experience has shown that the systemic or local use of sulfonamides will not prevent the development of local infection in a contaminated wound but it will keep an infection localized and thus prevent invasive infection. In penetrating wounds of the abdomen the prophylactic value of the sulfonamides has been amply demonstrated. The sulfonamides are of undoubted value in acute infections due to hemolytic streptococcus, the pneumococcus and the gonococcus but are of little or no value in infections due to the hemolytic staphylococcus. In certain mixed infections caused by both gram negative and positive organisms sulfadiazine has been of great value.

In contaminated wounds both the local and systemic use of penicillin, as with the sulfonamides, will not prevent the development of local infection but there is ample evidence that parenterally administered penicillin may attenuate, inhibit, or localize any infection that does develop within the wound. Penicillin is effective against the hemolytic staphylococcus and is the chemotherapeutic agent of choice in such infections. It is often most effective against sulfonamide resistant strains of streptococcus and gonococcus. Recently extremely large doses of penicillin have been utilized with encouraging results. Penicillin has greatly lowered the mortality of staphylococcal septicemia and its use in carbuncles may even abort the infection. It is an excellent agent in the management of acute osteomyelitis and its use in a series of 64 cases reduced the mortality rate to 15 per cent. Surgical intervention usually being unnecessary and abscess formation infrequent. Penicillin is very effective against aerobic hemolytic streptococcal infection, and in the treatment of an aerobic streptococcal infection penicillin is far superior to the sulfonamides. Penicillin is of but little value in tetanus and evidence indicates that the successful management of tetanus depends not on

chemotherapy but on early diagnosis, adequate chemotherapy and control of convulsions. Hemolytic infections respond well to penicillin therapy as does the form of rabbit fever caused by the *Streptococcus moniliformis*. Penicillin is by far the chemotherapeutic agent of choice in the treatment of pyogenic disease. Doses of 1,000,000 units every 3 hours is a valuable adjunct to proper surgery. Penicillin has been much more effective than the sulfonamides in the treatment of actinomycosis and probably the best results are obtained in this type of infection by combining these two chemotherapeutic agents.

In some respects the clinical effectiveness of streptomycin has been rather disappointing. Many acceptable pathogens rapidly develop high degrees of resistance and thus successful streptomycin therapy depends upon the use of sufficiently large doses from the beginning with early surgical drainage of abscesses before the development of resistance. Streptomycin is indicated in tularemia and bacteremia due to gram negative bacilli. Meningitis caused by *Haemophilus influenzae* and *Escherichia coli* responds to combined intramuscular and intrathecal use of streptomycin. This drug is of great immediate but often only temporary value in urinary infections. Liver abscess, cholangitis and secondary peritonitis also respond well.

The new agent, bacitracin gives considerable promise but its evaluation awaits further experimentation.

F. J. LITTMAN, JR., M.D.

ANESTHESIA

Anesthesia for the Aged. JOHN B. DILLON, J. Am. M. Assn. 1947 35 977

At the Los Angeles County Hospital, Los Angeles, California, there has been a 60.1 per cent increase in the number of surgical treatments given patients 70 years of age and older in the past 10 years. The report deals with the administration of anesthetics to 900 patients over 70 years of age, during a period of 9 months. This geriatric group is analyzed statistically as to type of surgical treatment, the vital statistics including mortality studies.

The author discusses the anesthetic management of the aged patient through five general categories: (1) he stresses the importance of preoperative consideration of the patient to determine the anesthetic method best suited to him; (2) he emphasizes the importance of premedication keeping the drug dose minimal, and avoiding depression; (3) his discussion on the anesthetic agents and methods employed emphasizes also those methods and agents which should disturb the patient's physiology as little as possible; (4) operative care of the patient, particularly the use of blood and oxygen in the operating room, is essential if the patient is to have a maximum chance of recovery; (5) the immediate postoperative period is a critical one and proper care of these aged people and early mobilization is essential.

If these five factors are carefully considered and anesthesia is chosen on the basis of the patient's

physiology premedication is kept minimal and supportive therapy is used routinely then postoperative morbidity and mortality are more related to the effects of age and a preoperative pathologic state than to anesthesia and surgical treatment.

MARY KAUF M.D.
Anesthesiology 1947 8 453.

The analysis of the mechanism of anesthetic action began with the work of Overton. Meyer, and Traube each of whom attempted to correlate the anesthetic effectiveness of a wide range of substances with one or another of their physical properties. A second line of explanation of narcotic action initiated by Verwoerd, focused attention on chemical and metabolic relations. The chemical and physicochemical views are not mutually exclusive and the early work of Warburg soon brought them in fact, into a more comprehensive picture of narcotic action.

Recent work is directed overwhelmingly to a more precise analysis of the physicochemical mechanism of narcotic action and to the identification of the particular chemical links on which their action is manifested. Despite a number of specific negative findings there is a reasonably constant body of evidence indicating that narcotics do interfere with some link or other in the metabolic stream of non-ionic possibilities suggest both physical and chemical possibilities along the lines of the earlier theories.

The cytochrome system apparently is necessary and by careful exclusion narcotic action seems to be limited to cytochrome β or to an intervening flavoprotein. It remains possible, even in the enzyme experiments that narcotics inhibit the complete systems but not their fragments, by some relatively nonspecific physicochemical action rather than by blocking a particular postulated flavoprotein link. What the nature of such nonspecific action may be remains unknown, but many suggestions have been offered.

The author predicts that the use of electricity when more fully exploited will throw considerable light on the phenomena of depression and narcosis just as it has on the opposed phenomena of stimulation and excitation. Indeed the whole question of narcosis deserves careful consideration in relation to excitation for by whatever intermediate steps narcotics do interfere with mobilization of energy from the active membrane changes which are crucial to activity and activation. MARY FRANCES FOX, M.D.

Anaphylaxis and Anesthesia
Anesthesiology 1947 8 625.

A careful review of the literature on the protection afforded by ether anesthesia against anaphylactic shock shows evidence that is inconclusive and contradictory. The current study was undertaken in an attempt to determine whether ether does protect against anaphylaxis and also if such protection does exist, whether it is a property of anesthetic agents in

general. The method used was to induce anesthesia in experimental animals (mice and guinea pigs) without premedication. From the results of the study it was apparent that no generalizations could be made regarding the protection afforded against anaphylaxis by anesthesia.

Studies of two species reacting dissimilarly to the anaphylactogen indicate that the species peculiarities of anaphylactic shock so vary that any one anaphylaxis-inhibitory agent would fail to prevent the development of anaphylactic syndrome in all animals. In species developing bronchospasm as the primary manifestation of anaphylaxis cyclopropane anesthesia provides sufficient additive effect to accelerate the development of fatal spasm. It was concluded that ether anesthesia does not prevent anaphylactic shock in unpremedicated mice but actually enhances the manifestations of anaphylaxis and decreases the survival time following injection of the shocking dose of serum.

Cyclopropane anesthesia does not prevent anaphylactic shock in unpremedicated mice. However ether anesthesia in unpremedicated guinea pigs affords some protection against anaphylactic shock. Cyclopropane anesthesia does not prevent anaphylaxis in unpremedicated guinea pigs.

MARY KAUF M.D.
Pentothal Sodium Anesthesia in Poor Operative Risks. C. P. MARSH and M. H. RAMIREZ JAMES.
J. C. M. B. L. 1947 58 163.

This is a report of the use of intravenous pentothal sodium anesthesia in 155 patients on whom 96 major interventions on the genitourinary organs and 59 operations of short duration were carried out. There were no deaths or accidents. This is considered the method of choice for the poor cardiac risk and hypertension. It is followed by fewer complications and the renal secretion is unaffected during its administration. Anuria does not ensue. It is safe in the hands of the skilled anesthetist and when used on carefully selected patients. Recorded fatalities were due to improper selection of patients faulty technique, too high dosage and failure to supplement.

Further Studies on the Production of Cyclopropane-Epinephrine Tachycardia. J. W. STUTZ and QUINN MURPHY C. R. ALLEN and W. J. MERRILL.
Anesthesiology 1947 8 579.

This study was undertaken to determine the site of action of cyclopropane in sensitizing the site injected epinephrine. Since nembutal does not interfere with cyclopropane-epinephrine tachycardia this agent was used as the preliminary anesthetic for the procedures designed to eliminate cyclopropane from the cerebral or body circulation. The results of these experiments indicate that for the production of cyclopropane-epinephrine tachycardia cyclopropane and epinephrine do not have to reach the cerebral circulation but certain brain cen-

ters must be intact and functioning. Furthermore, the addition of cyclopropane to the cerebral circulation does not alter the duration of the cardiac irregularity. In view of these results and the fact that the cardiac sympathetics must be intact, it appears that the heart is reflexly sensitized by cyclopropane.

In an attempt to locate the afferent pathway of such a reflex the spinal cord was cut below the main cardiac sympathetic outflow. These experiments suggest that afferent impulses entering the cord below T 6 are involved in reflex cardiac sensitization.

The effect of excluding cyclopropane from the region innervated by these nerves was tested. The results indicate that cyclopropane stimulates receptors located in the mesentery or abdominal viscera distributed for the most part throughout the peripheral 3 cm. of mesentery. Impulses travel by visceral afferent fibers through the celiac and superior mesenteric plexuses, splanchnics, and spinal cord to a brain center above the pons. Efferent impulses then pass to the heart by way of the cardiac sympathetics and increase the irritability of the heart.

MARY FRANCES POZ, M.D.

Variations in the Signs of Acute Oxygen Want during Anesthesia. C. R. ALLEN, R. S. ECHOLS, E. A. HOFFMANN, K. C. O'NEAL, and H. C. SLOCUM. *Anesthesiology* 1947 8: 60

In the anesthetized or heavily medicated subject hypoxia or asphyxia may result in irreversible tissue damage or even death without the intervention of the usual warning signs of distress. The general signs and symptoms of hypoxia such as mental and sensory dullness, headache, and excitement are absent, and the signs that remain for the clinical anesthetist to consider are cyanosis, marked dilatation of the pupils, and variations in pulse rate, blood pressure, and respiration.

In the present report the respiratory and circulatory effects of hypoxia and asphyxia are studied in dogs which were under the influence of various anesthetic drugs. Seventy-five dogs were used. The effects of acute oxygen want were produced by having the dog breathe pure nitrogen or by allowing the animal to rebreathe the air from a one liter bag connected to an endotracheal tube through a carbon dioxide absorber. Asphyxia was produced by clamping the trachea or by rebreathing a one liter air sample without a carbon dioxide canister in the line. Blood oxygen and carbon dioxide combining power determinations were made preliminary to the experiments. Arterial blood pressure and venous pressure electrocardiograms, and stethocardiograms were recorded simultaneously.

Twelve dogs were used for unanesthetized controls. In the unanesthetized animal mild hypoxia resulted in an increase in respiratory volume, a change without change in blood pressure. More severe decrease of hypoxia caused a rise in blood pressure in addition to respiratory increase.

During the progressive increase in the degree of oxygen want three stages are defined. The pre-

crisis stage (when the inspired air contains 12.5 volumes per cent oxygen) which shows an increase in both rate and depth of respiration due to stimulation of the aortic and carotid bodies. In this stage the systolic pressure tends to increase and the diastolic remains unaltered, or slightly decreased. The increased heart rate and reduced peripheral resistance tends to increase the minute flow of blood through the body. The second stage occurs when the blood oxygen concentration is reduced to about 9 volumes per cent and circulatory crisis occurs. The heart begins to dilate and the systolic pressure begins to fall and bradycardia occurs. There is an increase in diastolic volume and the output of the heart increases. This is caused either by central hypoxia or by chemoreceptor reflexes and is mediated by the cardio-inhibitory nerves. There is a gradual fall of arterial pressure and a rise in venous pressure. In the latter part of this period the pulse rate gradually increases as the cardioinhibitory center loses its effect upon the heart because of central depression.

The third stage is a terminal one and occurs when the blood oxygen concentration has been reduced to 4 volumes per cent or less. There is a rapid fall of blood pressure and the terminal slowing of the pulse. The heart will stop immediately or go into ventricular fibrillation.

The slow bounding pulse of oxygen want did not occur in the experiments in which pentothal sodium, deep ether or nitrous oxide with premedication of morphine and atropine were used. When nitrous oxide and oxygen without premedication were used the vagal slowing occurred early in the period of asphyxia. With light ether and with surgical anesthesia in planes 2 and 3 of cyclopropane or chloroform marked periods of bradycardia occurred.

Arterial pressure rose in response to the central action of carbon dioxide in all the asphyxiated animals except those in which profound anesthesia was used. The blood pressure response to hypoxia was markedly reduced by sodium pentothal and by light ether anesthesia, and did not occur with deep anesthesia. An increase in respiratory rate and tidal volume occurred in response to asphyxia.

The danger of excessive premedication in an effort to employ smaller concentrations of anesthetic agents is stressed. The report primarily intends to be a reminder that the warning signs of asphyxia and hypoxia vary with the depth of anesthesia and with each drug employed. Attention is called to the fact that death from acute oxygen want may occur in the operating room without the patient evidencing such significant developments as a slow bounding pulse, a gradual arterial pressure fall or a period of "physiologic gasping."

MARY KARP, M.D.

Hydrogen Ion Concentration of the Spinal Fluid and Its Relation to Spinal Anesthetic Failure. ELLIS V. CORCORAN and RALPH T. KURTZ. *Anesthesiology* 1947 8: 594.

The authors report failure of the spinal anesthetic agent in 2 patients in whom extreme alkalinity of

the spinal fluid was present. The occasional failure to obtain analgesia even after repeated injections of spinal agents may be due to such a hydrogen ion concentration of the spinal fluid that precipitation of the drug as a base occurs. Experimental work was done to determine the upper pH limits above which the anesthetic agents would precipitate when mixed with solutions of cerebrospinal fluid. The drugs were:

- 1 Procaine—50 mgm. per cubic centimeter of 5 per cent glucose solution.
- 2 Nupercaine—1 mgm. per 15 cubic centimeter of 0.5 per cent saline solution
- 3 Pontocaine—5 mgm. per cubic centimeter of 5 per cent glucose solution
- 4 Lontocaine 1:1 with 3.3 mgm. per cubic centimeter of 3.3 per cent glucose and 16.6 mgm. of epinephrine per cubic centimeter
- 5 Alety—30 mgm. per cubic centimeter of Ringer's solution.

These mixtures of anesthetic agents were then mixed with normal spinal fluid in the ratio of 2 parts spinal fluid to 1 part agent mixture and the resultant pH was determined. They were then titrated with 0.05 normal sodium hydroxide until the first persistent cloudiness appeared.

From this work it became evident that as the pH of the spinal fluid rises slightly past the pH 8 many of the common spinal anesthetic agents are precipitated and become ineffective analgesic agents for intrathecal use. The normal range of pH of spinal fluid was determined on 50 consecutive cases from specimens taken preoperatively. The pH ranged from 7.35 to 7.70.

It was concluded that high alkalinity of spinal fluid is an occasional finding in certain patients and may be the cause of spinal anesthetic failure when other possibilities have been ruled out. It may actually be harmful to the patient to inject certain agents if high alkalinity is present for the insoluble crystals of anesthetic base may cause a nerve tissue irritation.

MARY KARP, M.D.

SURGICAL INSTRUMENTS AND APPARATUS

Preoperatively Applied, Mated Plaster of Paris Casts as an Aid in the Migration of Open Pedicle Cross Leg Flaps. RICHARD B. STARR, *Plast Reconstr Surg.*, 1947, 3: 433.

The most expedient and satisfactory method of covering foot and leg wounds which overlie bone or in which further underlying damage will necessitate the repair of bone, tendons, or nerves is the open moderately well standardized. The procedure has become after this migration the legs are immobilized in a variation of this procedure in the use of preoperatively applied mated plaster of Paris casts to facilitate and expedite the operation.

The advantages of preoperative application of the casts are that (1) casts can be carefully applied and

padded adequately (2) the operator's time is reduced (3) trauma to the pedicle flap is lessened (4) subsequent care is facilitated by windows cut in casts (5) with preoperative implantations of metallic holding devices into the casts they may be secured in position so that a sterile dressing may be applied. If a cast has to be applied postoperatively the flap must be kept in view thus inviting infection. In the 35 cases in which the pre-cast method was used no infections have developed.

The prep is done through the windows in either cast. The casts are draped by rolling them with two layers of sterile stockinette. LOUIS T. BYARS, M.D.

Metallic Sutures and Ligatures. W. WAYNE BARCOCK, *Surg Clin N America* 1947, 27: 1435.

The employment of metallic sutures and ligatures is not of recent origin and dates back to the ancient Greeks. In 1816 Hysnick suggested the use of lead wire sutures with which Mehtauer first successfully closed a vesicovaginal fistula in 1832. Later Sims was similarly successful with silver wire. A number of current reports indicate that the use of nonirritating metallic sutures for closure of wounds leads to superior results and permits the patient early ambulation more safely.

The author commenced using stainless steel wire in 1928 and since 1931 he and the surgical staff of Temple University have used a finer annealed alloy steel wire for sutures and ligatures in over 20,000 operations except for short periods when tantalum wire was substituted. Of 200 inguinal hernioplasties with an all wire technique only 1 wound infection occurred whereas there were 6 infections in a similar number in which catgut also was used. Among 1,000 abdominal operations in which closure of the wound was effected by wire alone only 1 wound separated but in a similar number in which catgut was introduced 7 suffered dehiscence.

Moreover studies on wound healing revealed that the lag period the delay before progressive union occurs is the result of irritating sutures. Catgut either plain or chromic, was found to be the greatest offender grossly in the formation of adhesions, and microscopically, in the production of inflammation and necrosis the extent varying directly with the amount used. Silk was less irritating but stainless steel wire caused little if any such sequelae.

Not only must metallic sutures and ligatures be strong flexible and practically inert in living tissues to avoid chemical or electrolytic reaction but they must not stain. Of the elements, only tantalum meets these requirements and of the alloys only stainless steel appears adaptable at present. The latter is so strong and resistant to chemical and thermal change as to be called the new noble metal. Tantalum wire does not possess the tensile strength which comparable soft annealed stainless steel wire does nor is it as smooth. It therefore does not slide so readily into a knot where it becomes more brittle and weaker. Moreover tantalum has a low resistance to heat and it is many times more expensive to

isolate and process into wire as compared with the alloy; however, it is more resistant to repeated flexions and extensions and may be preferable for buried continuous sutures.

The author and his staff prefer sutures and ligatures of stainless steel wire as well as plates of this alloy which are lighter and more adaptable at the time of operation. Neither metal when buried appears to be hazardous when the tissue is irradiated. It is prudent, however, not to expose large plates such as those used to fill skull defects to the hot sun or x rays for long periods.

The use of wire calls for special technique. Twisting leads to kinks and difficulty in the tying of knots and may be avoided by preparing sutures and ligatures in short butties of straight lengths. Clamping the end of the wire prevents injury to the hand or rubber glove. Only square knots should be used, these being tied best with the aid of a bismontat. A surgeon knifed or tied with one hand may slip and pull apart. The ends should be cut up on the knot to avoid projecting joint which if close to the surface may cause discomfort and may precipitate a law suit. When an exceptionally large number of arteries are to be ligated fine silk, cotton or nylon is preferred to gain more rapid and secure ligations.

For most operations 35 gauge for closure of the skin, fat, fascia and serosa, 32 gauge for suture of

the thinner aponeurosis, as in children, and 30 gauge wire for heavy fascial layers, muscle sheaths, and aponeurosis will suffice. Occasionally a 35 gauge suture with a very fine needle may be necessary for a divided nerve or a small tendon. Multifilament strands of wire may be used for continuous external since they withstand a greater number of bending movements; however, since they would appear to have a greater tendency to carry or hold infection along the suture tract than a plain wire, the monofilament is preferable as a buried suture in contaminated fields.

Among the many instances in which stainless steel sutures and ligatures have been employed to advantage by the author have been the repair of diaphragmatic hernias, external intestinal fistulas, vesicovaginal and rectovaginal fistulas, cleft lips and palates, perineorrhaphies, the one stage pull-through operation for rectosigmoid carcinoma, the reconstruction of the biliary and pancreatic ducts, and the approximation of the serosal layers when intestinal continuity has been restored.

Screens or cloth of fine annealed tantalum or stainless steel wire have been used to reinforce irradiated areas and to prevent the stretching of tissue. They have also been helpful in plastic surgery when the restoration and maintenance of a contour were necessary.

D. W. H. LYNN, M.D.

PHYSICO-CHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Symmetrical Calcification of the Cerebral Basal Ganglia. Its Roentgenologic Significance in the Diagnosis of Parathyroid Insufficiency
JONAS D. CAHILL *Radiology* 1937 49 568.

Twelve cases of symmetrical calcification of the cerebral basal ganglia in which there was definite clinical evidence of parathyroid insufficiency and tetany are presented. In addition the author briefly reviews the literature. The author briefly presents the roentgenographic picture of the diseases besides parathyroid insufficiency and other with this symmetrical calcification of the cerebral basal ganglia.

As early as 1855 Virchow observed calcification of the basal ganglia but not until quite recently has parathyroid insufficiency been associated with it. The pathological basis for the roentgenologic changes is a colloid deposition in and around the finer cerebral vessels with subsequent calcification of the deposits which coalesce and form vascular sheaths and concretions. These pathologic changes are most likely to be detected roentgenologically in parathyroid insufficiency and other diseases characterized by mental deterioration with or without convulsive seizures or motor symptoms referable to the extrapyramidal system. All of the 12 cases presented showed symptoms characteristic of parathyroid insufficiency namely cataracts, convulsions, mental retardation and trophic changes. The serum calcium in all 12 cases was below normal levels.

Roentgenographically symmetrical calcification of the cerebral basal ganglia is earliest seen as small irregular discrete, symmetrically distributed shadows of increased density in the region of the various basal ganglia, especially the putamen and caudate nucleus. As the masses of calcium coalesce the roentgen shadows become larger denser and more obvious. Coincident cerebellar calcification may be observed at any stage of the disease as well as evidence of calcification in the deeper layers of the cerebral cortex. These shadows should not be mistaken for evidence of neoplasm. The fact that the shadows are bilateral and symmetric helps to exclude the diagnosis of brain tumor. In case of doubt pneumographic studies will aid in the diagnosis. Calcification of the choroid plexus and this may simulate calcification of the basal ganglia. However calcification of the choroid plexus usually occurs in the region of the genu of the lateral ventricle and in the lateral view of the skull this region lies posterior to the basal ganglia.

Calcification of the cerebral basal ganglia can occur in diseases other than parathyroid insufficiency. It has been observed in patients with a previous history of encephalitis, tuberous sclerosis, toxoplas-

mosis and mental deficiency since birth. One case seen at the Mayo Clinic had no obvious cause for the calcification. In another case a mild hyperthyroidism and a positive Kahn test were the only clinical findings. Patients who give a history of previous encephalitis and have calcification of basal ganglia often show other discrete areas of calcification throughout the cerebrum. This is true also of patients with tuberous sclerosis. In toxoplasmosis the calcification in the basal ganglia occurs as large dense, irregular masses surpassing any changes observed in parathyroid deficiency. Here again other nodules of calcification are distributed throughout the cerebrum.

In conclusion the author emphasizes the importance of thinking of parathyroid insufficiency when ever symmetrical calcification of the basal ganglia is observed. It is possible that some cases of marked cerebral calcification associated with mental deterioration and convulsive seizures reported in the literature may have been due to parathyroid insufficiency. A serum calcium determination would have made the diagnosis. The response to adequate treatment in such cases, and the possibility thereby of salvaging an occasional mentally retarded or handicapped person or child justifies the search for parathyroid insufficiency in the presence of roentgenographic evidence of symmetrical calcification of the cerebral basal ganglia.

JONAS D. CAHILL M.D.

Roentgen Therapy in Chronic Mastitis GROVER E. PEAKLER and FLORENCE P. KERRICK. *Phyiotherapy* 1937 50 134.

Roentgen therapy in chronic mastitis is advised and justified according to the authors on the basis that practically all productive inflammatory or hyperplastic tissue when properly treated responds to a greater or lesser degree.

Chronic mastitis is a term applied to a condition of the breast characterized by pain and tenderness usually preceding the menstrual period and by a diffuse or localized nodularity of the breasts which is often bilateral and which most often affects the upper outer quadrant. A discharge from the nipple is at times associated with chronic productive mastitis and may be the only symptom. If the discharge is serous the condition is usually benign but if bloody the condition is frequently due to cancer. The technique used consists of from 4 to 6 treatments through a 6 by 8 cm. field usually beginning with the upper outer quadrant. The second treatment is given a week later from the opposite side of the breast. The third treatment is given a week later and then the fourth fifth and sixth treatments are given four weeks apart. Each treatment represents a 50 per cent erythema dose with high voltage rays. The authors use constant potential 180 kv. with 15 ma.

for 15 minutes, at 50 cm. distance and 0.5 mm. of copper which is 375 roentgens, or an equivalent dosage using 200 kv.

During the past 25 years 151 patients have been treated. Of these 111 were cured or markedly benefited, 25 were practically cured, 11 were benefited but had slight residual thickening and 4 showed no change. Of the 151 patients treated, 30 had local excisions of tumor tissue and of these 30 only 1 showed cancer. There were 4 patients in whom the thickened tissue persisted and mastectomy was insisted upon.

FRANK L. HUBERT, M.D.

Teleroentgenotherapy of Cancer of the Breast Especially in Inoperable Cases (De l'etion de la Teleroentherapie dans les cancers de sein et spécialement dans les formes inoperables) GARY D. LINT, Ed P. PILLON, *Pres. Med.* 947 57 641

The author states that total irradiation of a cancerous organism involves humoral reactions which produce variable results in the evolution of the tumor. Their recent experiences with the teleroentgenotherapy and semiteleroentgenotherapy of cancer of the breast led them to foresee some interesting possibilities of this method.

After a brief general review of the data published by various investigators on the total irradiation which is somewhat uncertain, the authors want to show by their precise clinical observation what one can expect from this method. Their technique uses 200 kv., 0.5 mm. copper F.S.D. 140 meter including all of the trunk when there are diffuse bony lesions, or 1 meter when there is a mammary lesion to be treated including the thorax only. The daily or 3 doses weekly vary from 25 to 75 roentgens per exposure according to the condition of the patient and tolerance used. The total dose varies from 150 to 750 roentgen per series of irradiation which may be repeated after from 3 to 6 months if necessary.

The effect on the bony metastatic lesions in 12 patients was as follows: 4 excellent results, 4 good results, and 4 mediocre results. The pain was rapidly relieved and the general condition was improved.

The effect on the pleuropulmonary metastatic lesions was not as good as the bony lesions. However there was a sedation of the cough, pain and dyspnea.

The effect on the tumor was as follows: (a) in 12 cases of scirrhus: 2 failures, 4 mediocre results and 6 excellent results; (b) in 4 cases of carcinomatous lymphangitis and perimammary infiltration: 1 great improvement and 3 mediocre results; (c) in 4 exophytic and ulcerated cases: 1 excellent and 3 mediocre results; and (d) in 8 cases with multiple local nodular lesions and adenopathies: great improvement in 4 cases and 4 mediocre results.

The authors state that teleroentgenotherapy has a particular mechanism of general action because the dose administered is not big enough to be cytolytic and this was confirmed by histological examination before and after treatment. The interrelationship of the hypophysis, thyroid and parathy-

roid may play a certain role. The influence of the ovaries has been mentioned also. The majority of patients irradiated on the trunk at 140 meters castrated in some time by this treatment. Those irradiated on the thorax are still menstruating. In general, better results are shown in patients past the menopause or in whom the menopause was induced.

The authors concluded that semiteleroentgenotherapy used with prudence is always harmless. The action of this treatment is still not understood entirely, but there is no doubt about its good general effect. It seems that one can expect more from it, and consider it on the level of local preoperative and postoperative radiation which permits the surgeon to remove the tumor in full quiescence, and the authors say that this is the treatment procedure they are using now.

MARC K. P. SUT, M.D.

Parallaxtic Fluoroscopy as an Aid in the Bronchoscopic Extraction of Foreign Bodies. (Gen. Weiden) *Acta radiol. Stockh.* 947 28 33

Fluoroscopy is valuable to the bronchoscopist in extracting radiopaque foreign bodies. The biplane fluoroscope has been advocated by Jackson and others; however this procedure requires considerable time. For this reason, the author has returned to the single plane fluoroscope. Under its control the bronchoscope can be guided to the foreign body. By moving the screen to and fro in a transverse position, a form of stereoptical impression is obtained. If the foreign body image moves more than the foramen, it is located dorsally; if it moves less, it is ventral. As both move together, the forceps are in the correct plane. Six cases of foreign body localization by means of fluoroscopic parallax are described in detail.

MAURICE D. SUT, M.D.

Transitory Focal Pulmonary Edema and Eosinophilia (Loeffler's Syndrome) ARTHUR T. HURD, GEORGE and CARLETON B. PEIRCE, *Int. J. Radiol.* 947 38 391

The authors describe a case which they classify as an example of Loeffler's syndrome in an allergic individual. In 1931 Loeffler of Zurich drew attention to a hitherto undifferentiated condition, not identifiable with any known disease and characterized by transitory roentgenological lung shadows and pronounced eosinophilia, with for the most part an extraordinary absence of symptoms and clinical signs. Fourteen of Loeffler's 51 cases were discovered accidentally. The patients had no complaints except that the majority did have the mild complaint of tiredness or fatigue. Slight cough was not unusual. Sputum, if any, occasionally showed eosinophils, never tubercle bacilli nor *Ascaris lumbricoides*. Characteristically the chest roentgenograms had pulmonary shadows of the nature of patch areas of increased density, which occurred in any pulmonary area and lasted from 7 to 30 days; they disappeared in one area to reappear in some other area. Concomitantly a pronounced increase in blood eosinophilia constitutes the third major feature of

the syndrome. The white blood cell count in Loeffler's series varied from normal to 15,000.

The authors' case was that of a patient whose personal and family history bore evidence of his allergic predisposition. The patient was sensitive to house dust and ragweed pollen and also exhibited evidence of bacterial allergy to the infecting organism namely the *Haemophilus influenzae* a constant finding in the sputum and infected sinuses. On readministration of specific vaccine for the *Haemophilus influenzae* he developed joint and muscle pain and fever and marked purpura of the Schoenlein type and during this episode there was transitory electrocardiographic evidence of a bundle branch lesion with subsequent normal tracings. This was considered evidence of vascular allergy. By the same token the transitory Loeffler shadows seen in the lung may with propriety be regarded as allergic edema involving the capillary network of the interalveolar tissues of the lung.

FRANK L. HURLEY M.D.

Roentgen Demonstration of Calcifications in the Interventricular Septum in Cases of Heart Block

FRANK WINDHOLZ and CHARLES GRAYSON
Am J Roentg 1947 58 411

Of a series of 61 patients who on roentgen study showed calcifications in the mitral annulus fibrosus in the aortic ring or in their valves, 12 suffered from heart block. In all the cases of heart block calcifications of the septum were associated with calcifications of the aortic or the mitral ring. The mitral ring was involved in 9 cases, the aortic valve in 3 cases. No calcified tricuspid rings were found in any cases. The location of the septum was correlated to that of the adjacent calcified ring or valves by using postmortem specimens of cases studied roentgenologically during life. In studying the relationship of the septum to the mitral and aortic rings the observations were made more precise by roentgenograms taken in typical projections of a heart specimen in which the rings were marked with a wire loop and the septum with a bit of wire fly screen. In this way not only the spatial interrelationship of the structures but also their overlapping and foreshortening in roentgen examinations could be demonstrated.

Three types of roentgen signs are recognized which are considered as indicative of the presence of calcareous deposits in the membranous septum:

1. Caudal extension of calcium shadows from calcified aortic valves or aortic ring.
2. Complete circular or crescent shaped calcifications about the mitral ostium.
3. Incomplete mitral ring calcifications with nodular thickenings of calcareous deposits at the right (medial) end of the posterior branch of the calcified mitral ring.

Roentgen signs of calcium deposits in the septum are, as a rule, associated with heart block or prolonged conduction time. At times calcifications can be demonstrated roentgenologically in the septum with no clinical or electrocardiographic signs of heart block.

FRANK L. HURLEY M.D.

X-Ray Signs of Altered Alimentary Function following Autonomic Blockade with Tetraethyl ammonium

JOHN F. HOLT, RICHARD H. LYONS, ROSALIE B. NALIGH, GORDON K. MOZ and FRED J. HODGES. *Radiology* 1947 49 603

Tetraethylammonium is a quaternary ammonium compound structurally similar to acetylcholine. Animal experimentation had shown that intravenous or intramuscular injection of the drug produced a rather specific blockade of the transmission of nerve impulses through the sympathetic and parasympathetic ganglia.

Clinical use showed that the drug produced widespread autonomic nervous system effects. Certain hypertensive subjects showed a significant drop in both systolic and diastolic pressure and in 1 such patient, who also had a duodenal ulcer, the ulcer pain stopped completely during the activity period of the drug.

The drug has relieved pain and increased temperatures in peripheral vascular diseases associated with vasoconstriction. It is a useful diagnostic tool in assaying sympathetic tone in candidates for lumbar sympathectomy. It appears of limited value in the symptomatic treatment of hypertension.

There was no effect upon the esophagus particularly in reference to the relief of cardiospasm.

The stomach promptly became atonic and remained quiet for the duration of the drug activity. The appearance was strikingly similar to that seen following vagotomy.

With intravenous administration there was a rather dramatic cessation of intestinal movements lasting for only a few minutes. Intramuscular injection produced similar changes which persisted for as long as 3 hours. The mucosal markings appeared to be fixed in one position. This did not occur in every case but it was too frequent to be coincidental. Meckel's immediately precipitated peristalsis. Atropine alone and adrenalin even in high doses never stopped peristalsis.

No appreciable change was noted in the colon although the bowel could be distended without producing a desire to defecate.

The drug should prove to be a useful agent in further investigation of both the normal and disordered autonomic nervous system.

J. P. TOMBULA, M.D.

Roentgenologic Aspects of the Chronic and Intermittent Varieties of the Transverse Axis Type of Volvulus of the Stomach

(Il quadro radiologico del volvolo gastrico sull'asse trasversale nelle sue varietà cronica e intermittente) MICHELE CESARINI. *Arch Ital mal app diger* 1947 13 249

Five cases of gastric volvulus on the transverse axis, that is the axis passing through the cardia and the pylorus, are reported. All of the patients were middle aged, 4 females and 1 male, and all had suffered from dyspepsia and epigastric pain. In 4 of these individuals the attacks had been intermittent and in 1 the gastric distress had been more or less

continuous resulting eventually in malnutrition and marked debility. In the 4 intermittent cases the volvulus was of the subcolic variety: the transverse colon passed above the kink in the stomach and the splenic flexure which, lying above and to the left of the cardia was markedly distended with gas, and pushed up and partially immobilized the left cupula of the diaphragm. In each of these patients the stomach showed a tendency to revert to its normal position and configuration after a few hours. In 1 case the correction of the abnormality was accompanied by the discharge of large quantities of gas from the anus. In another the volvulus recurred when the left colic flexure again developed gaseous distention. In the chronic case, in which the abnormal posture of the stomach could not be redressed e. g. by placing the patient horizontally on the right side, the colon was depressed down beneath the shadow of the stomach in a double barreled shotgun appearance and seemed bound in place by adhesions. In this instance also the spleen could neither be palpated nor demonstrated roentgenologically (ectopic spleen).

In every case the roentgenologic picture was the same: the opaque material would pass into the stomach from the esophagus downward and to the left through the fundus, and then upward and to the left into the dilated corpus and antrum which were lying far to the left, uncovering the pyloric region and duodenum. After the fundus, corpus, and antrum had filled, the shadow crossed over in front of the shadow of the fundus and continued downward and to the right to the pyloric region. The pylorus itself appeared to be drawn upward and to the left and to be increased in length.

The various theories of pathogenesis are discussed. In every case in this material the stomach when reduced hung lower than normal giving some support to the theory of the relaxation of its supporting ligaments. The relationship of the attacks to food taking suggests the importance of overloading and distention of the stomach and the possible significance of gaseous distention of the colon and of adhesions has already been alluded to. However the author gives the greatest attention to the question of the malposition of the spleen in these patients, and he believes that it is now incumbent on the roentgenologist to determine the incidence of splenic ectopy in this malady as a splenectomy may at times be indicated.

JOHN W. BRENNAN, M.D.

Malocclusion Deformities of the Greater Curvature of the Stomach MAURICE FELDMAN *Radiology* 94:7 49, 1952.

In the educational program now being conducted to make the general public cancer minded more and more "normal" variations will be encountered which must be differentiated from malignancy.

The author reports 9 cases presenting marked irregularities of the greater curvature of the stomach which imitated malignancy but which by gastroscopy and surgery and following a long period of

observations proved to be due to hypertrophic gastric rugae. In many of these cases the first roentgen impression was suggestive of carcinoma.

Great caution must be observed in the interpretation of mucosal abnormalities and filling defects in the greater curvature of the stomach, especially in those cases which present defects which do not conform to the usual disease pattern. Repeated roentgen studies combined with gastroscopic and clinical studies are essential.

Marked hypertrophic rugae are not ordinarily consistent with carcinoma; however such changes are present in Hodgkins' or lymphoblastoma disease and syphilis. Giant rugae are also seen in gastritis associated with peptic ulceration.

R. B. LEVIN, M.D.

The Role of the Radiologist in the Management of Patients with Intestinal Obstruction, with Special Reference to the Use of the Miller-Abbott Tube. ELLIS C. OSGOOD, *Radiology* 96:491 539.

The radiologist has become an important figure in the study of patients suspected of having intestinal obstruction. Often he is the second physician to see the patient, even before the patient is sent to the surgeon. For this reason he must be familiar with the physiological changes which take place following obstruction, and with the manner in which to make certain of the diagnosis and the location of the obstruction. He must take into consideration the history, as well as the clinical course and physical findings if he is to make the correct diagnosis at the earliest possible time. Often he cannot make a flat roentgen diagnosis of a definite obstruction but may be able to offer valuable confirmatory evidence as to the presence of distention and its possible cause. With the help of a barium enema and studies of the chest, as well as scout films of the abdomen, he may even be able to offer some idea as to etiology of the distention and as to whether it is of a mechanical or reflex nature. He may be of much help in choosing the course of treatment but the actual treatment must be decided upon by the surgeon.

The examination should consist of an anteroposterior Bucky film of the abdomen together with a comparable erect film and decubitus films in both lateral positions. If possible for the patient, fluoroscopy of the chest should be employed. The interpretation of these films should answer the following questions: (1) Is gas present in the intestine and in what portion? (2) Is it normal or pathological in amount? (3) Is it due to mechanical obstruction or reflex causes? (4) If obstruction is present, where is it? (5) If the distention is reflex is there anything to suggest the etiology?

The earliest sign of a small bowel obstruction is the finding in the survey film of the abdomen of a small segment of distended gut. One may see a kink or a so-called "hair pin" loop. Such an appearance may be present as early as 4 hours after the onset of symptoms. There is usually no fluid seen at this time. As

the obstruction persists the distended segment increases in length fluid appears and the coils of distended gut seem to lie horizontally in the abdomen to produce the stepladder appearance. The upper small intestine pattern may be fairly normal but the lower part of the small gut loses its markings and as the process progresses there is a gradual loss of all characteristic markings with a tendency of all the distended loops to look the same. The position of the loops in the abdomen may be of some help in determining the part involved. Distention of the colon is more easily identified by its position visible haustral marking fecal contents and the scarcity of small bowel gas. The latter condition depends on whether the ileocecal valve is patulous or not. If this valve is closed in cases of obstruction of the colon a closed loop obstruction occurs. It is in this type of case that the cecum becomes so tremendously distended that rupture of the cecum becomes a real danger. The exact location of the lesion in the colon may be determined by finding the point where there is an abrupt ending of the distention with no gas or not an abnormal amount beyond. In these cases the barium enema will help to locate the lesion exactly. Obstructive lesions just distal to or just proximal to the ileocecal valve may make the distinction between small bowel and large bowel obstruction very difficult. This is true especially of inflammatory lesions in this area.

Several points in differential diagnosis between obstruction as described and distention due to reflex origin are discussed. In cases of reflex distention both the small and large bowel are involved. The distention is less likely to be so uniform and there is an absence of a pattern suggesting continuity which is the rule in organic obstruction. Reflex ileus occurs in cases of pulmonary infection, gastrointestinal infection, cholecystitis and cholelithiasis, irritation of the peritoneum, renal stones, uremia, vascular accidents and many other acute and chronic conditions. All such conditions should be thought of and looked for in all cases of intestinal obstruction, especially in the cases without typical intestinal colic. In their presence the diagnosis must be proved by a barium enema or the passage of the Miller Abbott tube.

The Miller Abbott double lumen tube has many advantages in cases of intestinal obstruction. Suction can be applied which decompresses the bowel proximal to the obstruction, peristalsis then returns and the tube progresses. A normal segment of bowel is then available for the introduction of nourishment and fluids. The removal of the distention alone helps to prepare the patient for an operation and in cases in which the tube comes to a definite stand still the injection of a thin barium mixture through the distal lumen may help determine the exact point of obstruction as well as the nature of the lesion. Following the operation, the continued use of the tube in the intestine prevents distention, protects the suture line, and makes the convalescence smooth. In surgical procedures involving resection of the large bowel the prophylactic introduction of the tube has

proved of value. There are a few contraindications to its use. It must not be used in persons known to have or suspected of having strangulation or gangrene of the bowel if operation is thus delayed. The tube should not be used in obstructions of the large bowel. In these cases there is an increase of tonus of the terminal ileum which makes progress uncertain and delays entry of the tip into the cecum and the cecal contents are usually too grumose for aspiration through the tube. If the ileocecal valve is open and there is a reflux distention of the small bowel decompression may be an advantage while the patient is being prepared for operation. The author goes into minute detail describing the technique of the passing of the tube with the advice that the procedure be in the hands of a team well acquainted with the difficulties which may be encountered and the various ways of successfully overcoming them. He believes that the radiologist would do well to accept the responsibility of intubating the patients since it is often to his advantage in making the diagnosis and since he must be present to do the fluoroscopy. He must also limit the time of the fluoroscopic exposure as well as the number of films taken since the procedure may take several days. The patient is usually kept in the radiology department and is handy for the radiologist who probably has more time than the surgeon and a better idea as to how often and when to make the necessary exposures. The entire procedure requires study and experience to be done successfully and to furnish the most information in helping to locate the lesion and deciding when to operate. Persistence and patience and experience are most important and lack of these will result in failure to use a valuable adjunct in making a correct diagnosis.

During the period that the tube is progressing, the length passed is watched as well as the speed and the manner of movement. In cases of simple mechanical obstruction the progress of the tip of the tube is apt to be fairly rapid to the point of obstruction. In cases of reflex ileus it will be much slower but often will increase as the edema and distention of the gut are relieved. The balloon must be kept inflated and constant adequate suction maintained to keep the tube progressing. When the tip of the tube seems to be definitely stopped a thin barium mixture may be injected under fluoroscopic guidance in order to study that part of the gut. If distention is present in the intestine proximal to the tip and adequate suction has been maintained, one can be sure that there are other areas of obstruction distal to this point, or other complicating reflex factors such as a generalized peritonitis or other cause. The actual point of obstruction must be visualized by means of barium in order to rule out a paralytic ileus. Palpation and maneuvering of the patient are used to endeavor to make the head of the barium column advance. The obstruction may seem to be complete clinically but the barium may seem to advance intermittently with peristalsis and the presence of intestinal colic. In these cases removal of the tube or stopping of the suction will bring back active intestinal colic. This

is observed in cases of incomplete obstruction. In these cases the bowel just beyond the head of the barium should appear normal but if there are any pockets of distention or fluid one knows that there are other areas of obstruction more distally. Often in cases of complete obstruction the removal of the distention may so improve the condition of the intestine that the symptoms may entirely disappear and contemplated surgery be made unnecessary.

The author concludes that the use of the Miller Abbott tube is a very important adjunct in the correct diagnosis and treatment of intestinal obstruction, and he quotes statistics to show a marked overall decrease in the mortality rate in cases of intestinal obstruction of all types treated surgically and in which intubation with suction has been used in the treatment. A note of warning is sounded against the set routine use of an one procedure without sound clinical evaluation and judgment of the individual case. The author presents case histories to illustrate his own experiences.

This article is well worth close scrutiny and filing for future reference. PAUL H. SWITZER, M.D.

Malignant Tumors of the Small Intestine. HOWARD P. DOON. *Radiology* 94:7 49 44

Malignant tumors of the small intestine are being diagnosed with increasing frequency, mainly because of a more widespread use of serial roentgenography. As a rule lesions of the duodenum and upper jejunum are discovered during routine examinations of the stomach but those occurring below that level require a special technique which consists in the administration of a mixture of 4 ounces of barium sulfate and 8 ounces of water on the morning of the examination with the stomach empty. A preliminary fluoroscopic study of the esophagus and stomach is made and as much barium as possible is forced through into the duodenum so that this organ also is examined at the same time. Fluoroscopy of the small intestine is then carried out and supplemented with roentgenograms at 30 minute intervals until a complete emptying has taken place unless obstruction is present. Golden states that on damage results from the administration of barium sulfate by mouth. Since the contents of the small intestine remains fluid the barium can be removed by suction in case of obstruction.

The author's series of malignant tumors of the small intestine includes 52 cases. In 23 cases the tumor was located in the duodenum, in 16 cases, the jejunum and in 13 cases the ileum. The pathologic distribution was as follows:

	Duodenum	Jejunum	Ileum	Total
Carcinoma		9	4	13
Lymphosarcoma		3	4	7
Carcinoid			3	3
Leiomyoma				
Stenosis carcinoma				5

Grossly the tumors were of two types (1) the constricting type and (2) the fungating or polypoid type.

As a rule the clinical picture was characterized by a progressive loss of weight, the presence of varying degrees of anemia and a change of bowel habit leading not infrequently to acute obstruction. A palpable tumor was an important and significant finding.

The most important roentgen signs were a narrowing of the lumen of the bowel with dilatation proximal to it, and marginal or central filling defects associated with obliteration of the mucosal markings in the involved area.

Tumors of the duodenum. In the author's series 17 per cent of the tumors were in the superampullary portion, 61 per cent were in the perampullary portion, and 22 per cent in the infraampullary portion of the duodenum. Clinically tumors of the superampullary portion often presented symptoms of gastric obstruction. In the perampullary group the most common localizing sign was jaundice. There was no jaundice associated with the infraampullary tumors, but patients often vomited large amounts of bile. In about 50 per cent of all duodenal tumors a palpable mass was present. The roentgen signs were dependent upon the amount of deformity or obstruction of the duodenum. They varied from a regular constriction of the lumen to large filling defects. Reverse peristalsis, gastric retention, and secondary duodenal displacements were common. In 12 of the author's patients there were definite localizing defects. In 4 there were obstructive lesions with high-grade gastric retention, and various typical deformities were found. In 3 patients the findings were entirely negative, 2 patients were not examined roentgenologically.

Tumors of the jejunum and ileum. These tumors produced a similar clinical and roentgenological picture. The clinical syndrome was usually that of obstruction, produced either by gradual encroachment of the growing tumor on the bowel lumen or by intussusception. As the tumor became more obstructive, pain assumed a more prominent role in the picture. Nausea and vomiting were rather constant symptoms. The most significant finding was a palpable tumor or a sense of resistance without tenderness. Secondary anemia was the rule and the stool examinations usually remained positive for occult blood. The outstanding roentgen findings were partial or complete obstruction with dilatation of the proximal bowel and filling defects with mucosal alteration.

Lymphoblastoma. This type of tumor occurred most frequently in the ileum. Acute obstruction is uncommon since the invasion is intraluminal rather than intraluminal. For the same reason occult bleeding was found rarely. The characteristic roentgen signs were areas of narrowing and adjacent areas of dilatation with aneurysmlike appearance.

Carcinoid tumors. In the author's series these tumors were noted only in a few instances but the literature contains numerous reports of larger groups.

The case histories are presented on 1 patient with duodenal tumor, 4 patients with jejunal or ileal tumors, and 1 patient with lymphohistoma. Some very excellent roentgenograms are used for the purpose of illustration.

T. LECOTIA, M.D.

Roentgenological Examinations of Ileus. J. FRANK DARR. *Acta radiol.*, Stockholm, 1947, 28, 331.

The author presents the roentgenological findings of ileus. The forms of ileus are classified under mechanical ileus which includes simple obstruction from without incarceration under adhesions, internal hernias, volvulus and functional ileus which includes paralytic and parietic ileus, and ileus following neurovascular changes.

In simple obstruction the findings are those of gas and fluid collecting in varying amounts in the bowel. With horizontal rays hoop-shaped loops are seen with two small fluid levels, generally one in each limb of the loop. While the bowel is active it strives to press its contents past the obstruction and it is for this reason that the column of gas shows upright loops that are arched in form on account of peristaltic movement. On fluoroscopic examination the fluid levels rise and fall with fluid levels at different heights in the same loop. It is the rule that the nearer strangulation is approached the less the peristalsis is seen. Repeat examinations may be necessary to demonstrate the peristaltic movement. There is some distention of the prestenotic loops with persistence of the circular folds of the mucosa. The portion of the intestines below the stenosis will contract and tend to empty its contents. It is important to notice that there is an absence of fluid levels if there is a small amount of gas retained in the colon. The contents of the colon below the stenosis should be solid. In some cases there is rapid exudation of fluid into the peritoneal cavity. If the ileus persists a few days the gas usually increases in amount and the number of loops increase; these loops then lie above one another and extend as bands across the abdomen to produce a stepladder effect. There is seldom gas in the stomach.

In strangulation ileus there are many degrees of incarceration. In cases of this type when the compression is slight the findings are those of a simple obstruction. Some of the cases show scant findings. If the strangulation is incomplete there is gas both above the stenosis and in the involved loop. The fluid levels tend to remain more at equal heights than in simple obstruction. In some cases in which the incarceration and stenosis are complete there is a typical picture of ileus, while in others there are scanty signs. The incarcerated loops may produce a tumorlike opacity with a multicircular border. A mechanical ileus of the colon sometimes produces a picture that will resemble that of an ileus of the small bowel especially if the obstruction is in the cecum near the ileocecal valve. In cases of this type the ileocecal valve is usually open which allows the adjacent small bowel to distend. In obstruction of the colon there is fluid and air above the stenosis with

formation of fluid levels in the horizontal ray. The colon below the obstruction is empty. A barium enema will decide the diagnosis.

Paralytic ileus is distinguished from mechanical ileus principally in that both the small and large intestines are affected. Because of diminished peristalsis the bowels are not definitely hoop-shaped but long and lax. Gas and fluid are retained in both portions of the gut and are uniformly spread according to the severity of the paralysis. In the colon the fluid levels are fragmented. In peritonitis there is fluid between the intestines and obliteration of the extraperitoneal layer of fat.

In mesenteric thrombosis the differential diagnosis is between an ileus of the small intestine and a peritoneal reaction. The roentgen findings in this condition are difficult to define correctly and the diagnosis of peritoneal irritation only may be made. Gas filled loops of the small intestine with fluid levels and fluid and gas in the ascending colon may be found in some cases.

A long-standing mechanical ileus and a paralytic ileus are difficult to differentiate. An acute abdominal condition is best investigated without barium, however a small amount of barium may be given by mouth to aid in the determination of the site of the obstruction. The fluid in the loops of bowel above the stenosis dilute the barium. Repeated examinations may provide evidence of whether the condition is deteriorating or improving and are likewise an especially good basis for determining the indications for operation.

FRANK L. HUSSEY, M.D.

Microarteriography. A. E. BARCLAY. *Brit J Radiol* 1947, 20, 394.

During the course of experimental study of the intrarenal vascular system in rabbits to determine the causation of traumatic necrosis, it was soon suspected that under certain conditions the blood circulating through the kidney takes a short cut from the arterial to the venous side leaving the cortex either partially or completely ischemic. It became desirable, therefore to work out a much finer radiographic technique than that customarily used to demonstrate these arteriovenous communications.

The author describes the various stages of development of such a procedure until finally a satisfactory technique has been obtained.

Photographic emulsions. Owing to the rather large size of grains, the ordinary radiographic films were found unsuitable. The author experimented with four types of photographic emulsions: (1) the Ilfex a radiographic film which is employed with out intensifying screens and was used chiefly for radiography of the excised specimens; (2) the Process, an emulsion employed for lantern slides and contact film reproduction; (3) the Kodak film which was much favored during the war for miniature photography; and (4) the Maximum Resolution or more recently the Kodak 500 type MR plates emulsion No. 1565 both of which are capable of resolutions to 1,000 lines.

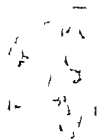


Fig. 1

Fig. 1 (Barclay) Contact print of a roentgenograph of a section (240u) of a rabbit kidney injected with radiopaque material. Factors: Crystallography diffraction tube with beryllium window k 15, ma. 50 distance 8 in. maximum resolution plate (Kodak 5 type MR plate, emulsion No. 1565) exposure 3 minutes.

In general the finer the grain the longer the exposure that is necessary. If the factor of Ilfex is taken as 1, Process will need 50 Kodakline 100 and Maximum Resolution 2,000 times the exposure. In other words an exposure of 1 second on Ilfex will be equivalent to an exposure of 30 minutes on Maximum Resolution, all settings remaining the same.

Use of softer rays Since the wall of an ordinary x-ray tube absorbs too much of the very soft radiation diffraction tubes with aluminum beryllium or lithium windows were found more satisfactory. The author first tried a gas filled diffraction tube and with a Maximum Resolution film he obtained such fine detail that the kidney vessels were visualized down to those of capillary size.

The present apparatus consists of a half wave transformer coupled up to a Blachlett shockproof hot cathode diffraction tube, operating at 5 to 50 kv. and up to 50 ma. To eliminate the vibration which is a disturbing factor a special casing was made which encloses the tube head and thereby renders the unit not only self-contained but also safe from stray radiation. Hence the room which houses the apparatus can also be used as the dark room.

Technique The radiographic factors depend on the thickness of the specimen. The organ is injected with radio-opaque material, in vivo or after excision and is fixed in the usual way. After the whole organ is radiographed sections are made of areas that give the maximum vascular pattern for study. The most suitable thickness of the sections is from 120 u. to 450 u.

Mounting of specimen It is desirable that the specimen be in direct contact with the emulsion. The floating of the section into position in water or a 50 per cent mixture of water and glycerine is unsatisfactory since wet films lose their sensitivity to a considerable extent. After numerous investigations the author found that the tissue supplied for heat mounting of prints constitutes the most satisfactory waterproof material. Therefore the section (after being washed in water and placed in 50 per cent glycerine and water to prevent evaporation when long exposure is necessary) is transferred on the tissue, the surplus fluid is blotted out, and the tissue is placed on the film in the cassette which is then exposed. At a distance of 8 inches and with a current of 50 ma. the exposure of a section of 240 u. on



Fig. 2 (Barclay) Enlargement (15x) from roentgenograph Fig. 1

Maximum Resolution film amounts to 5 minutes when using 50 kv. and 1 1/4 minutes when using 20 kv.

Injection media. Opaque media used for angiography fall into 3 categories (1) true solutions including diodrast, uroselectan, pyelosal, etc., all of which contain iodine (2) colloidal preparations, including thorocontrast, colloidal metallic gold (red), 15 per cent colloidal silver iodide and colloidal metallic bismuth and (3) insoluble metallic salts, including bismuth carbonate, red lead and jeweller's rouge. The author found that thorocontrast, colloidal gold, silver and bismuth pass readily through the capillaries to the venous side. The jeweller's rouge may also prove to be of value.

Enlargements The contact radiograph represents a true size of the organ or section examined showing the injected radio-opaque material distributed in the vessels. (Fig. 1) This negative can be enlarged by means of a good lens on ordinary photographic paper to about 10 to 15 times, giving the vascular pattern as a whole and thus forming a link between the macroscopic and the microscopic methods of study (Fig. 2) By making a photomicrograph of the negative a further magnification is obtained, up to 50 times. This permits a visualization of the detail of the capillaries and every injected vessel (Fig. 3) Finally by enlarging the photomicrograph on ordinary photographic paper it is possible to obtain



Fig. 3 (Barclay) Photomicrograph (x 50) of roentgenogram. Taken from cortex of kidney, Fig. 1 showing the glomeruli, afferent and efferent vessels, and the subcapsular network of capillaries.

another 5 fold magnification giving a total enlargement of 250 (Fig. 4) T. LELCOTIA M.D.

Giant Cell Tumors of Bone. FRANKLIN B. BOGART and ALLISON E. IMLER *Radiology* 1947 49 432

From January 1, 1942 to October 1, 1945 a total of 656 patients were admitted to an army hospital designated as Radiation Therapy Center. Of these, 10 had giant cell tumors of bone. The authors present 4 cases which are illustrative of various features of the disease. In 3 the giant cell tumor was located in the spine and in the fourth case the tumor was at the upper end of the tibia.

While most giant cell tumors of bone are benign a few become malignant or are malignant from the onset. To establish a correct diagnosis routine biopsy is desirable. With present-day surgical skill no hazard is involved in such a procedure.

If the tumor is proved to be malignant radical surgery is indicated in cases in which the lesion is accessible. Patients in whom the tumor appears to be benign may be treated by radiation therapy. The use of relatively small doses is advocated. The authors agree with the assertion of Pfahler and Parry that when there is no damage to skin and soft tissues there will be none to the epiphyses. In children, a series of approximately 100 to 200 roentgens delivered into the tumor and repeated at intervals of from 1 to 3 months for two to four series appears entirely safe. In adults the authors used a



Fig. 4. (Barclay) Enlargement (x 250) of a group of glomeruli from photomicrograph, Fig. 3, i.e. an enlargement from Fig. 1 of x 250

tumor dose as high as 1,500 roentgens with a second series of half that amount 2 months later but this does not seem to be necessary.

A combination of surgery and radiation therapy, as is often advised for the treatment of giant cell tumors, is not always recommendable. In structures such as the spine for example it is disadvantageous

to use even curettage. As a rule, tumors which have been treated surgically from the beginning and which recur should again be treated surgically as their subsequent response to radiation is unsatisfactory.

The authors are of the opinion that if a malignant change has been discovered later it is probable that the tumor was malignant to start with. It is illogical to assume that the malignant transformation was induced by the irradiation or some other causative agent. A bibliography of 28 articles is appended.

T. LEUCUTIA, M.D.

MISCELLANEOUS

The Clinical Sequence of Physiological Effects of Ionizing Radiation in Animals. C. LADD PROSSER, E. E. PAINTER, HERMAN LISCO, AUSTIN M. BRUCE, and Others. *Radiology* 94:7 40 299.

This report is on work done in the Metallurgical Laboratory of Chicago under the Manhattan Project. The authors believe there is need for a better understanding of the clinical effects produced by exposure to various types of both internal and external radiation. They worked with chickens, rabbits, mice, rats and dogs, using radiations from the x-ray tube, cyclotron, and uranium pile, as well as those of internally administered radioactive isotopes.

Various doses given at different exposure rates gave varying results in the different species, but the authors were able to present four main generalizations on the basis of their detailed study of the animal physiology before death and the microscopic pathological histology after death. These were as follows:

1. Every kind of ionizing radiation is similar in its clinical action whether it be penetrating external radiation or internal radiation from deposited material.

2. Nearly every organ system is affected by lethal doses of every type of radiation. Some of the effects are direct and others are indirect.

3. No single clinical reaction is peculiarly specific for radiation damage.

4. The clinical picture and the conditions resulting in death vary with the dose rate and the duration

of exposure for both external and internal radials. If an animal survives one depression with a onset of symptoms, he is apt to die later of a direct mechanism.

The authors have identified a series of data patterns which lead to death after irradiation.

1. Immediate death due to the administration of a high dose and dose rates causing rapid cellular destruction.

2. Initial shocklike death in about 48 hours, due chiefly in rabbits and chickens. The symptoms were prostration, vomiting, diarrhea, and anorexia, and a fall in blood pressure, granulocytosis, and hypopenia.

3. Early death in from 4 to 6 days with evidence of dehydration, hemoconcentration, intestinal emaciation, and leucopenia.

4. Acute deaths, comprising most of the deaths from all types of ionizing radiation except external beta rays. They occur in from 9 to 21 days after treatment. There is severe leucopenia, thrombocytopenia, bleeding, altered water balance, terminal tetanic fever, reversal of the albumin globulin ratio, high nonprotein nitrogen, high serum protein, and cardiovascular failure.

5. Subacute changes leading to death later. There was aplastic anemia, hyperplastic macrocytic anemia, liver degeneration, emaciation, and bone and bone marrow lesions.

6. Chronic irradiation deaths which occurred from 3 to 24 months or more after treatment. In this group tumors are the important cause. Ovarian tumors have resulted from gamma and x-irradiation. Leucemias have been accelerated in appearance by penetrating irradiation. Skin carcinoma has resulted from external beta radiation. Bone sarcomas appear after prolonged irradiation with strontium 90 and Pu and Ra. Premature aging, emaciation, and other types of chronic irradiation injury lead to death after prolonged exposure at low dose rates.

The whole article is very timely with the increasing availability of many radioactive isotopes and should stimulate all to inquire deeply into the many hazards of this type of radiation.

PAUL I. SHIFFER, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

The Thermostability of the Toxin Components of Clostridium Welchii Type A J. H. MASOX
S Afr J Med Sc 1947 13 61

The alpha toxin of the *Clostridium welchii* is heat stable to a considerable extent. It is not completely destroyed when heated to 120 C. for an hour. The theta toxin is heat labile.

Autoclaved toxin stimulates the formation of alpha antitoxin when it is injected into rabbits and horses.

A small quantity of Welch alpha antigen is retained in pulp used for clarifying *Clostridium welchii* cultures even when the pulp is subsequently autoclaved and washed. When such pulp is used to clarify a *Clostridium septicum* culture sufficient Welch antigen is carried over into the septicum toxin to stimulate the formation of Welch alpha antitoxin in horses in which this septicum toxin is used for hyperimmunization purposes.

SAMUEL KAHN, M.D.

Experiences in the Surgical Treatment of Multiple Visceral Neoplasms. ALEXANDER BRONSCHEIN and PAUL W. SCHAEFER. *Ann Surg* 1947 126 780

The case histories of 9 patients in whom there was a multiplicity of malignant or benign symptom-producing neoplasms of various viscera are reviewed. They are classified into three groups:

1. Those with multiple tumors situated close to one another and producing symptoms clinically attributable to one growth. In these patients the multiplicity of the growths was discovered only at operation or upon study of the pathologic specimens.

2. Those with 2 tumors rather widely separated and manifesting simultaneously the symptomatology of 2 separate growths.

3. Those in whom one growth was excised to be followed later by the development of a second independent growth which in turn was also resected.

In this series the stomach was the site of multiple neoplasms in 2 instances, the colon in 3 instances, the larynx and the esophagus in 1 instance, the esophagus and the stomach in 1 instance, the stomach and the colon in 1 instance, and the papilla of Vater and the colon in 1 instance. Not all of the lesions were malignant. In 2 instances the lesion in the stomach was benign and in 1 instance one of the colonic lesions was benign, but in 2 of these cases the benign lesions produced symptoms.

The classical teaching is to ascribe as often as possible all symptomatology to one pathologic process. In the case of neoplasms, especially malignant, recurrence of symptomatology in the great majority of instances is due to recurrence of the neoplasm and/or its metastases. However, sufficient data has

now been published to indicate that the multiplicity of neoplasms producing symptoms synchronously or successively as they develop is not an extreme rarity and in the follow up of patients having had one neoplasm resected this possibility is to be borne in mind.

JOHN H. MONTVOT, M.D.

Protein-Chemical Aspects of Cancer GERALT TORX
Adv. Cancer Res., 1947 7 193

This is a summation of the important data obtained to date regarding the protein-chemical aspects of cancer. Because of poorly developed micro-technique and because of the structural organization of the cell an overall analysis obviously affords limited insight into the significance of changes in chemical composition. The recent development of analysis by means of isotope dilution and micro-biological assay have greatly increased the analytical precision and specificity for many proteins. More useful information awaits future developments.

FRANK B. QUEEN, M.D.

Radical Treatment of Malignant Melanomas of the Lower Extremities. ERNEST M. DALAND
Surg Clin N America 1947 27 1136

This article reports the history and course of 3 cases of malignant melanomas of the lower extremity which spread along the subcutaneous lymphatics and involved the saphenous and inguinal nodes. Radical surgical treatment consisted in the removal of the primary lesion, regional node dissection and excision of all the intervening skin, fat and fascia.

The patients are free from disease 13½, 3½ and 3 years later respectively although in each case several operative procedures for removal were required before the lesions were completely eradicated. There has been no permanent disability from the operative treatment. STEPHEN A. ZIEGLER, M.D.

Report of Clinical Experiences with Homografts. W. P. LONGBRIDGE, JR., H. B. STONE, A. S. DANIEL, and C. D. GOODE. *Plast Reconstr Surg* 1947 2 419

As the popularity of free skin grafting spread in the latter part of the nineteenth century it was generally accepted that skin from one person could be grafted on another and the literature contained numerous reports of successful homografts.

From 1910 on published reports indicate that homografting in human beings has not been permanently successful. Investigations have indicated that blood groupings of donor and recipient have nothing to do with the permanent take of a homograft. The only clearly authentic cases of permanently successful homografts were presented by Brown and McDowell in monozygotic twins.

Medawar approaches the problem of making a successful homograft by trying (a) to alter the tissues of the graft so they are no longer antigenic to

to use even curettage. As a rule, tumors which have been treated surgically from the beginning and which recur should again be treated surgically as their subsequent response to radiation is unsatisfactory.

The authors are of the opinion that if a malignant change has been discovered later it is probable that the tumor was malignant to start with. It is illogical to assume that the malignant transformation was induced by the irradiation or some other causative agent. A bibliography of 28 articles is appended.

T. LEUCUTA, M.D.

MISCELLANEOUS

The Clinical Sequence of Physiological Effects of Ionizing Radiation in Animals. C. LADD PACE-SER, E. E. PARRER, HERMAN LISCO, ADOLPH M. BAUME, and Others. *Rad. story* 1947 49: 399.

This report is on work done in the Metallurgical Laboratory of Chicago under the Manhattan Project. The authors believe there is need for a better understanding of the clinical effects produced by exposure to various types of both internal and external radiation. They worked with chickens, rabbits, mice, rats and dogs, using radiations from the x ray tube, cyclotron and uranium pile as well as those of internally administered radioactive isotopes.

Various doses given at different exposure rates gave varying results in the different species, but the authors were able to present four main generalizations on the basis of their detailed study of the animal physiology before death and the microscopic pathological histology after death. These were as follows:

1. Every kind of ionizing radiation is similar in its clinical action, whether it be penetrating external radiation or internal radiation from deposited material.

2. Nearly every organ system is affected by lethal doses of every type of radiation. Some of the effects are direct and others are indirect.

3. No single clinical reaction is peculiarly specific for radiation damage.

4. The clinical picture and the conditions resulting in death vary with the dose rate and the duration

of exposure for both external and internal radiation. If an animal survives one depression with a certain set of symptoms, he is apt to die later of a different mechanism.

The authors have identified a series of clinical patterns which lead to death after irradiation.

1. Immediate death due to the administration of a high dose and dose rates causing rapid cellular destruction.

2. Initial shocklike death in about 48 hours, seen chiefly in rabbits and chickens. The symptoms are prostration, vomiting, diarrhea and anorexia, with a fall in blood pressure, granulocytosis, and hypopenia.

3. Early death in from 4 to 6 days, with evidence of dehydration, hemoconcentration, intestinal damage and leucopenia.

4. Acute deaths, comprising most of the deaths from all types of ionizing radiation except external beta rays. They occur in from 9 to 21 days after treatment. There is severe leucopenia, tissue breakdown, bleeding, altered water balance, terminal toxemia, fever, reversal of the albumin globulin ratio, high nonprotein nitrogen, high serum protein, and cardiovascular failure.

5. Subacute changes leading to death later. There was aplastic anemia, hyperplastic macrocytic anemia, liver degeneration, emaciation and bone and bone marrow lesions.

6. Chronic irradiation deaths which occurred from 3 to 24 months or more after treatment. In this group tumors are the important cause. Ovarian tumors have resulted from gamma and x-irradiation. Leukemias have been accelerated in appearance by penetrating irradiation. Skin carcinoma has resulted from external beta radiation. Bone sarcomas appear after prolonged irradiation with strontium 90 and Pu and Ra. Premature aging, emaciation, and other types of chronic irradiation injury lead to death after prolonged exposure at low dose rates.

The whole article is very timely with the increasing availability of many radioactive isotopes and should stimulate all to inquire deeply into the hazards of this type of radiation.

PAUL L. SWITZER, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

The Thermostability of the Toxic Components of *Clostridium Welchii* Type A J H MASON *S Afr J Med Sci* 1947 12 61

The alpha toxin of the *Clostridium welchii* is heat stable to a considerable extent. It is not completely destroyed when heated to 120 C. for an hour. The theta toxin is heat labile.

Autoclaved toxin stimulates the formation of alpha antitoxin when it is injected into rabbits and horses.

A small quantity of Welch alpha antigen is retained in pulp used for clarifying *Clostridium welchii* cultures even when the pulp is subsequently autoclaved and washed. When such pulp is used to clarify a *Clostridium septicum* culture sufficient Welch antigen is carried over into the septicum toxin to stimulate the formation of Welch alpha antitoxin in horses, in which this septicum toxin is used for hyperimmunization purposes.

SAMUEL KARN, M D

Experiences in the Surgical Treatment of Multiple Visceral Neoplasms. ALXANDER BRUNSWARTZ and PAUL W SCHAFER. *Ann Surg* 1947 26 780

The case histories of 9 patients in whom there was a multiplicity of malignant or benign symptom-producing neoplasms of various viscera, are reviewed. They are classified into three groups:

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STEPHEN A ZIMMAN, M D

Report of Clinical Experiences with Homografts. W P LONGMIRE JR, H B STONE, A S DANIEL, and C D GOOM. *Plast Reconstr Surg*, 1947 2 419

As the popularity of free skin grafting spread in the latter part of the nineteenth century, it was generally accepted that skin from one person could be grafted on another, and the literature contained numerous reports of successful homografts.

From 1910 on published reports indicate that homografting in human beings has not been permanently successful. Investigations have indicated that blood groupings of donor and recipient have nothing to do with the permanent take of a homograft. The only clearly authentic cases of permanently successful homografts were presented by Brown and McDowell in monozygotic twins.

Medawar approaches the problem of making a successful homograft by trying (a) to alter the tissues of the graft so they are no longer antigenic to

the host (b) to find a donor whose unaltered tissues are compatible with those of the recipient.

In the authors' experiments pinch grafts were transferred simultaneously from 71 donors to a single recipient. Although all grafts "took" none were permanent. Thirty-two grafts showed spreading epithellum for 24 days, then rapidly disappeared thereafter. At the time of final observation (the fifty-fourth day) two collagenous pads were all that remained of the grafts.

The results indicate mathematically that if skin transplantation groups do exist there are at least 23 in number.

Histological studies of a homograft transplanted as a pinch graft into a bed surrounded by normal skin suggest that what appears to be a permanent survival of the homograft is actually an overgrowth of the area by the tissue of the host.

Ashley in 1937 reported the successful use of infant foreskins as homografts in 2 cases. The authors' investigations in a series of 24 foreskins from newborn infants as homografts on 5 different patients showed that none of them survived beyond the fourteenth day. They have therefore been unable to confirm the report of the successful use of infant foreskin as permanent homografts.

LOUIS T. BYARS, M.D.

Urgent Surgery in the Aged. CONROBT W. CUTLER, J.
A. M. Surg. 1947, 26, 765.

In this excellent article on surgical emergencies in the aged the author summarizes his experiences in 185 cases. The 304 patients who comprised the basis of these observations ranged in age from 60 to 102 years, an average age of 74 for the group.

The factors of deterioration and diseases of senility in chronic and advanced forms give the problem of urgent surgery in the older age group its special character. These conditions often entail difficulties in early and accurate diagnoses since the defects might mask or mimic conditions requiring quick surgical intervention. When an emergency arises, there is little opportunity to improve the patient's status and none to rectify the existing fundamental organic defects. Frequently encountered were myocardial degeneration, valvular heart disease, overweight, malnutrition, the results of previous coronary infarction or cerebral vascular accident, tuberculosis, lues, diabetes, anemia, vitamin deficiency states, hypoproteïnemia, arterial sclerosis, varieties of renal or hepatic dysfunction, or a combination of these defects. While the mortality attending surgery in this group was 44 per cent, the survivors represent surgical salvage or individuals who, unaided, would almost surely have succumbed. Of the 304 patients representing surgical emergencies, 15 were either in extremis or refused surgery, and all 15 succumbed.

These patients were poor operative risks and required maximum preoperative supportive and preparatory treatment. Such measures could not always be pursued to the desired extent without unduly delaying surgery. However, certain general principles

of therapy were adopted to meet the requirements of this type of case.

1. Every quickly available measure for support and protection should be utilized. Depleted blood and electrolytes should be replaced, impending acids should be prevented with glucose and insulin, new blood or plasma should be furnished, hydrolysis should be used to raise the blood protein level, concentrated vitamin solutions should be employed to promote tissue repair or to minimize hemorrhage, and anticoagulants should be used to overcome thrombotic or embolic states. When available, penicillin was administered every 3 hours preoperatively and postoperatively in doses of 100,000 units. The inability of the failing heart and kidneys to tolerate large quantities of fluid given rapidly by vein was recognized. The replacement of weight loss, and the administration of a high caloric diet and of morient proteins preoperatively were appreciated, but time was lacking to do this in these urgent cases.

2. The remedial operation should be undertaken with the least possible delay. Supportive measures should not delay unduly the performance of urgent surgery. Old persons deteriorate rapidly under stress, death of tissue, or obstruction of the intestinal tract. Delays in laboratory or x-ray investigation in ineffective efforts at intestinal intubation, or in trying to reach an unattainable optimum in the patient's condition may lead to failure.

3. With a minimum of trauma and in the shortest feasible time, the simplest procedure that will relieve the emergency should be done. Elective resections and anastomoses, meticulous repair of lesions, prolonged exploration of the bile ducts, cholecystectomy and plastic amputations will surely increase the mortality. The conditions for which operations were performed in this series over a 7 year period consisted of gangrene of the extremities, intestinal obstruction, inflammation and obstruction of the biliary system, appendicitis, and various infections.

4. Every means to safeguard the patient against postoperative complications should be employed and diligent watch should be kept for signs of their development. During the early postoperative hours shock was of first importance. Shock was combated with adequate amounts of blood and oxygen. Stimulant drugs were, in the main, disappointing. Preoperative and postoperative sedation must be cautiously managed since large doses of morphine are not well tolerated. Old people are particularly susceptible to pneumonia, wound disruption and sepsis. Many of them succumb even weeks after operation, to cerebrovascular accidents, coronary occlusion, uremia, anuria, and cardiovascular collapse. Pneumonia was the major cause of death (34% of deaths). Forty-nine per cent of the pulmonary complications began 10 days or more after operation. To prevent atelectasis, thorough aeration of the patient was regularly performed at termination of the operation and during the succeeding 24 hours; rebreathing procedures were carried out. Nurses were instructed to move and turn the patients fre-

quently to assure that a free airway was maintained and that no aspiration of vomitus occurred. These measures, plus the continued administration of penicillin were the best assurance also against pneumonia. The termination of bed rest was emphasized at the earliest possible moment, and it is believed that this practice reduced the incidence of phlebotomous and decubitus. In the patients who were out of bed early no case of wound dehiscence was encountered but it occurred in those who of necessity remained bedridden and was the product of distention, sepsis wound infection vitamin deficiency lowered blood protein or the presence of carcinoma rather than the muscular action produced by early rising. Phlebothrombosis though rare was treated by ligation and division of the superficial femoral vein of the leg showing involvement. If cryptogenic embolization occurred heparin plus dicumarol were relied upon.

General anesthesia properly chosen and administered was well tolerated by such patients. Ether was found to be reliable, safe and effective. Cyclopropane proved ideal combining low toxicity, rapid induction and recovery, and good relaxation permitting high oxygenation. Intocostin served to increase relaxation which permitted the use of smaller quantities of cyclopropane or ether. In view of the circulatory depression that frequently attends the use of spinal anesthesia, this method was treated with suspicion. Local anesthesia was found wanting for abdominal operations. Refrigeration anesthesia became almost routine after 1941. Pneumonia following operation, occurred in about the same relative frequency with each type of anesthesia employed and in about half of the cases it appeared to days or more after the anesthetic was given.

The pre-existing ailments of the patients were the greatest factor in a mortality of 44 per cent. Complications not directly attributable to the operation or to the emergency for which it was performed accounted for about half of the deaths. Prompt intervention may save well over half of the victims of acute surgical emergencies in old and chronically ill people.

JOHN MORHARDT, M.D.

DUCTLESS GLANDS

Transplantation of the Hypophysis of Cadavers in Cases of Simmonds Disease (Transplantation de l'hypophyse de cadavre dans le cas de maladie de Simmonds) E. KURAWA. *Lyon chir.*, 1947 45 305

The author reports 4 cases in which very favorable results were obtained in patients with Simmonds disease by transplantation of the hypophysis from cadavers. Previous attempts at such transplantation have utilized as recipient sites the subcutaneous tissue, the abdominal musculature, the preperitoneal space, and the omentum. The author has utilized the region of the sympathetic nerves about the internal carotid artery. It is important to utilize a cadaver of the same sex and approximate age as the patient. All

of the wounds have healed by first intention and the patients have been ambulatory by the third day.

All of the 4 patients were greatly benefited and this is illustrated by striking photographic comparisons. Two of the patients died subsequently of tuberculosis. The other 2 are living and in perfect health.

EDWARD W. GIBBS, M.D.

Primary Hyperparathyroidism ROBERT W. SCHENKEL, E. R. KROSA, JR. and E. PERRY McCULLOUGH. *Cleveland Clin Q* 1947 14 246

The authors present 10 proved cases of hyperparathyroidism associated with parathyroid adenomas. On histological examination 6 adenomas were described as being composed principally of chief cells. Attention is directed to a functioning oxyphil cell adenoma which apparently is rare and the unusual occurrence of the same type of tumor in a blood relative.

In presenting observations on 10 cases of primary hyperparathyroidism the multivariety of clinical pictures, laboratory data and x ray findings are emphasized. The reports of the 10 clinical cases are given in detail. Hyperparathyroidism in its most typical form presents hypercalcemia, hypercalcaemia, hyperphosphatemia, and hypophosphatemia. With extensive skeletal involvement high levels of the variable types of symptoms and degrees of severity of the disease it is important to recognize the milder forms of the disease since they may prove fatal.

The symptoms and findings are divided arbitrarily into three main groups.

Group 1 includes those resulting from hypercalcemia. These consist principally of muscular weakness and decreased muscular excitability. The muscles are frequently flaccid and opposite in type from those of tetany. Constipation is common, and nausea and vomiting may occur. Polydipsia and polyuria occur frequently and may be sufficiently severe to simulate diabetes insipidus. One half of the patients noted polydipsia and polyuria. Pyralism was noted in one patient.

Group 2 includes the symptoms referable primarily to the urinary tract. These are generally the first manifestations of the disease. In 8 of 10 patients there was a history of renal colic and in 6 there was roentgenological evidence of renal calculi. In 4 there was a history of bilateral renal colic and in 3 roentgen findings of bilateral stones.

Group 3 includes the symptoms referable to the skeletal system. Ill-defined skeletal pain was present in 4 patients and epulides in 2 both of the latter patients had loose teeth. Pathological fracture was incurred in one kyphosis was present in another and giant-cell tumor was found in still another. A roentgen diagnosis of osteitis fibrosa cystica was made in 5 of the 10 patients. Resorption of the lamina dura was observed in 4 patients of this series. In 4 of the 10 patients the tumors were aberrant in location. One was found in the mediastinum at

the level of the second rib 2 were located in the substance of the thyroid and apparently took origin from the left superior gland and one tumor arose from the left inferior gland between the esophagus and the trachea. Of the 6 remaining adenomas, 1 arose from the right inferior and 5 from the left inferior parathyroid. Two were palpable prior to operation. Of the 10 removed only 1 was located on the right side. The electrolytic balance was restored in all of the patients by removal of the parathyroid adenoma. Partial disability remained in some resulting from renal calculi or parenchymal renal damage.

In the differential diagnosis of such problems, myelomatosis, hypervitaminosis D, simple bone cysts, and primary renal disease must be considered. The Sulkowitch test offers an instant method of detecting gross hypercalcemia. A presumptive diagnosis depends upon the detection of the characteristic alterations of the serum phosphorus and calcium.

The pathological physiology of primary hyperparathyroidism resulting from excessive parathyroid hormone is discussed. JOHN H. MORAROT, M.D.

Effects of Steroids on Lactation. J. C. BARRAMIENTE and G. ROSS M. C. MASON. *Endocrinology* 94:74, 1959.

Most of the theories presented to explain the absence of lactation during the second half of pregnancy at a time when the mammary gland is fully developed attribute a predominant but indirect role to the steroid secretions of the ovaries and placenta. Many attempts have been made to reproduce experimentally with ovarian hormones and other steroids the conditions prevailing during pregnancy in order to inhibit lactation.

Estrogens, probably mediated through the ovaries, inhibit lactation in normal animals and in accordance with the dose and the time of initiation of treatment this inhibition is partial or complete. Clinical investigations on the effect of estrogens upon lactating women have given contradictory results; however, recent well controlled studies tend to show that a diminished secretion can be obtained even during active nursing.

Progesterone and ethinyl testosterone are inactive in human beings. The androgens have given equivocal results both experimentally and clinically as have hormones of the adrenal cortex. Combined treatment with progesterone and estrogens inhibits lactation in ovariectomized rats, which indicates a possible synergism between the two hormones.

In a previous article the authors reported that among the various steroids administered in the form of pellets to both normal and spayed lactating rats, only estradiol and testosterone inhibited lactation in normal rats. Since the absorption from pellets varies with the nature of the steroids, the possibility remained that the inactivity of some compounds was due to this factor. Therefore in the current experiments the steroids were administered at the same dose level in the form of an oil solution.

Comparison of the present results with those reported previously shows that compounds which are inactive when administered under the form of pellets, inhibited lactation when given subcutaneously in oil solution. Since all the factors were identical otherwise, it can be assumed that the difference in the results was due to the factor of dosage.

In normal rats estradiol in daily doses of 1 mgm or less and testosterone, androstenediol, and dehydroisandrosterone in daily doses of 10 mgm much inhibited lactation. The inhibitory effect of androstenedione, methyl androstenediol, methyl androstenediol, ethyl testosterone, ethinyl testosterone, ethinyl androstenediol, and methyl testosterone was less marked. Progesterone, acetovyl progesterone, pregnenolone and desoxycorticosterone were inactive.

The lactation inhibitory effect of these steroids is mediated through the ovaries, since these steroids are inactive in spayed lactating animals. There appears to be some relationship between the inhibitory effect of steroids and their ability to inhibit lactation. DAVID H. LIPP, M.D.

The Adrenal Cholesterol and Ascorbic Acid Contents after Injury. STEPHAN LUDWIG and K. H. CHAMUTIN. *Endocrinology* 94:74, 1959.

The experiments reported herein were performed to determine the changes in adrenal cholesterol and ascorbic acid after a variety of stresses over a period of several days. The authors note that decreases in the cholesterol and ascorbic acid content of the adrenal glands have been reported to occur after injections of adrenotropic hormone, hemorrhage, scalding, exposure to cold, and trauma. It was found that injury may produce initial decreases but also causes delayed increases in the cholesterol and ascorbic acid content of the adrenal glands.

The following agents (symbols) and dosages were used:

Bis (B-chlorethyl) sulfide	(H) 0.4 mgm/kgm.
Ethyl bis (B-chlorethyl) amine HCL	(HN1) 0.4 mgm/kgm.
Methyl bis (B-chlorethyl) amine HCL	(HN2) 0.6 mgm/kgm.
Tris (B-chlorethyl) amine HCL	(HN3) 0.6 mgm/kgm.

Sodium pentobarbital anesthesia in control rats causes a significant hypertrophy of the adrenal glands within a few hours. The adrenal cholesterol content is significantly decreased by the anesthetic during the first 6 hours; the free cholesterol is not affected. The adrenal ascorbic acid content is decreased within a few hours after anesthesia, and increases to above normal within 24 hours.

Severe thermal injury causes a marked decrease in adrenal ester cholesterol content during the first 24 hours which is followed by a persistent and marked increase after this time. The ascorbic acid content follows a similar pattern. Mild to moderate burns cause significant increases in the cholesterol and ascorbic acid content. The free cholesterol content is

not affected. After the intravenous injection of tria (B chlorethyl) amide the adrenal ester cholesterol decreases significantly. Intravenous injections of 3 nitrogen mustard and sulfur mustard cause significant increases in the adrenal ascorbic acid content after 24 hours. Cutaneous application of sulfur mustard is responsible for marked adrenal hypertrophy. The ester cholesterol is increased after the third day.

In the present investigation hypertrophy of the adrenal glands was apparent as early as the third hour after anesthesia. Anesthesia plus saline injections, severe burns and intravenous injections of HN_3 . The adrenal weights returned to normal only in the anesthetized rats, and the data illustrate the rapidity of the response of the adrenal glands to minimal injury. The most marked adrenal hypertrophy in the series of experiments was noted in the rats treated cutaneously with sulfur mustard. The skin lesions in these animals were not particularly severe, but diarrhea was noted in about half of the animals treated. In the scalded animals the extent of hypertrophy was related to the time of exposure to the hot water.

The delayed increases in the adrenal cholesterol and ascorbic acid content appear to be manifestations of the adaptation syndrome following injury.

JOHN H. MURKIN, M.D.

EXPERIMENTAL SURGERY

Toxoid Immunization in Experimental Gas Gangrene. W. A. ALTEMEYER, W. L. FURST, W. R. CULBERTSON, C. L. WADSWORTH and Others. *Ann Surg.*, 1947, 126: 509.

Thus far effective prophylaxis of gas gangrene has been limited to early and adequate surgery, but penicillin, administered parenterally, has been shown to be a very valuable therapeutic adjunct to surgery. Its prophylactic effect was greatest when it was used early and in massive doses and consisted of a limitation of the rate of spread and extensiveness of the infectious process as well as a marked retardation in the rate of death.

The possibility of producing active and effective immunity for this infection has been studied in recent years. Toxoids have been developed that have produced sufficient serum titers in laboratory animals to protect them from lethal doses of gas gangrene organisms injected into healthy muscle through fine needles.

From a surgical viewpoint however this does not simulate the conditions in clinical gas gangrene in which the organisms are found in large areas of grossly contaminated and devitalized tissue produced directly by trauma or indirectly by laceration or thrombosis of nutrient arteries. Furthermore, there is increasing evidence that the toxemia of gas gangrene is complex, being caused not only by the known bacterial exotoxins absorbed from the site of injury but also by other factors, possibly arising from the septic degeneration of devitalized tissue.

Consequently it seemed probable that the immunity reported thus far in experimental animals injected with toxoid inadvertently has been made to appear greater than it was.

The production of toxoid immunization against a more severe form of gas gangrene which closely simulates the clinical type was undertaken by the authors.

Guinea pigs were chosen as the experimental animals and *Clostridium welchii* toxoid was used to immunize them. Incisions under septic conditions were made in the thighs of the animals immunized and the muscles were crushed with Kocher clamps and then avulsed by twisting the clamps. In each wound 0.5 c.c. of an autoclaved and finely divided mixture of soil and cinders was placed. The edges of the wound were then closed. Finally 0.5 c.c. of the 1/100,000 minimum lethal dose was injected through the skin into the operative area containing the crushed muscle and dirt. Adequate controls were maintained.

These methods produced a more severe form of gas gangrene that required higher serum antitoxin levels (from 10 to 20 units per cubic centimeter) for protection than have been previously reported. The fact that it is more severe suggests that there is another toxic factor produced by the growth of virulent bacteria in crushed muscle.

Survival rates varied between 46 and 100 per cent under varying conditions. The best methods of producing long term immunity have not been established as yet but further work along this line is being done.

The high degree of immunity produced against the severe form of infection indicates that effective immunity is possible by the injection of toxoid against gas gangrene produced by the *Clostridium welchii* but the duration of the immunity is thus far undetermined.

Other studies are in progress to increase and extend the degree of immunity afforded by injections of *Clostridium welchii* toxoid and to produce similar immunization with toxoids of other clostridia associated with gas gangrene, in anticipation of the development of an effective mixed toxoid for human prophylaxis against clinical gas gangrene.

EDMUND R. DOMOGHUS, M.D.

Comparative Efficiency of Single and Multiple Dosage Regimens of the Penicillins. CHARLES G. ZORABO. *Bull. Johns Hopkins Hosp.* 1947, 81: 400.

Current practice in the use of penicillin G for the treatment of infections in man demands that a relatively constant blood concentration be maintained through frequent doses of penicillin. The author considers the experimental basis of different modes of administration in order to appraise how essential is the need for a constant penicillin blood level in the treatment of bacterial infections. Experiments were then undertaken to investigate the comparative efficiency of various dosage regimens of penicillin in a virulent hemolytic streptococcus in

fection in mice, and the pure penicillins G and K were used as the corative agents. The total amount of penicillin administered to the mice was kept constant and only the division of the total dose varied. No penicillin in oil and beeswax was employed and only the crystalline salts of penicillin G and penicillin K in aqueous solution were used.

In these experiments with a fulminating streptococcus infection in mice the controlling factor in the survival rate was the total dosage of the penicillins. Penicillin G and penicillin K had approximately the same effectiveness as antibacterial agents in mice when given every 8 to 24 hours as when given every hour. On this basis it seemed clear that the anti-streptococcal effect of aqueous penicillin G outlasted the measurable blood levels by many hours and the survival of the mice depended upon the total dosage administered over a fairly broad range of dose schedules. Large initial doses of penicillin G were advantageous in so far as they protected the mice for a much longer period than multiple smaller doses. The in vivo activity of pure penicillin K in streptococcal infections in mice was from one thirteenth to one-twentieth of that of pure penicillin G.

The author suggests that in the application of these experimental data to the treatment of bacterial infections in man one might try to use 300,000 units of penicillin G intramuscularly every 12 hours in the treatment of penicillin susceptible infections. In patients in whom treatment is begun late it would be important to try the effect of "large" initial doses of possibly 1,000,000 units immediately and again in from 8 to 12 hours followed by smaller doses administered at 4-hour intervals.

EDMUND A. CORVETT, M.D.

Comparison of the Carcinogenic Activity in Extracts of Human Liver and Other Human and Animal Organs. PAUL E. STENZEL, D. WERNER STAMMER, and MIRIAM N. BOYARD. *Cancer Res.* 1947 7 273.

The authors cite the possible existence of carcinogenic carcinogens in man. A considerable number of investigators have demonstrated tumor-inducing activity in extracts of noncancerous human liver. Both carcinomas and sarcomas have been induced by liver extracts: the former by application of the latter by injection of the extract. The tumor-inducing factor was found in the total lipid extract with benzene, and in the nonsaponifiable lipid fraction extracted with ethylene dichloride or with petroleum ether.

The authors attempted to discover endogenous carcinogens in other human organs as well as the liver by injecting extracts subcutaneously into mice of the C 57 black strain. Extracts of human liver, spleens, colons, hearts and livers were used; these were obtained both from cancerous and noncancerous individuals. Livers from stillborn infants and swine livers and bovine livers were also tested.

The experiments demonstrated a tumor-inducing factor in the nonsaponifiable lipid fraction of human liver from cancer-bearing and noncancerous persons. The combined percentage yields of sarcoma in two of two strains was 22.7 and 48.4 respectively. The extract from livers of stillborn infants was also carcinogenic. Hog liver showed evidence of activity but beef liver was negative. In the study of organs and tissues other than the liver only the cancerous spleen showed evidence of considerable tumorigenic activity.

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AORTIC VALVULOTOMY

Experimental Methods and Early Results

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IN a preliminary report (7) a technique was described for division of the aortic valve in dogs with a view toward developing a method which might be applicable to the surgical treatment of aortic stenosis in human subjects. The present report concerns the early results obtained by the technique described a presentation of a second method of valvulotomy and a comparison of the results obtained by the two procedures.

The first method consisted in brief of passing a specially devised valvulotome (7) through the wall of the ascending aorta manipulating it proximally within the aorta until the instrument became engaged within one of the cusps of the aortic valve (Fig 1). By manipulation of the sliding harbed blade of the instrument, the valvular leaflet was divided perforated, lacerated or partially avulsed (Fig 2a to g). Control of hemorrhage from the aorta after the withdrawal of the valvulotome was accomplished by tamponade of the aortic opening with an absorbable gelatin sponge or with oxidized cellulose secured in place by stay sutures in the periaortic fat. The results obtained by this method are considered below.

The second method of aortic valvulotomy which has proved safer simpler and more ef-

fective than the first consisted of division of one or more valvular leaflets by approaching the valve through the wall of the left ventricle using the same valvulotome described in the transaortic technique (7). The procedure was carried out in large adult mongrel dogs as follows. The thoracic cavity was opened through an incision in the left seventh intercostal space intravenous sodium pentobarbital anesthesia being used. Intrapulmonic positive pressure was obtained during the operation by an artificial respirator which delivered an interrupted flow of atmospheric air through an endotracheal catheter. Full exposure was obtained by self retaining rib-spreading retractors. The pericardium was opened widely from its aortic reflection to the cardiac apex. A traction suture of silk was placed in the left ventricular wall so as to deliver the inferior portion of the heart into the wound. In this manner the cardiac apex was exposed clearly and a purse-string suture of catgut was placed in an avascular area of the wall of the left ventricle at or near the apex. A small incision was made through that portion of ventricular wall included in the purse-string suture. The sheath of the valvulotome was manipulated through the incision into the cavity of the left ventricle with the hooked blade drawn up within the protecting sheath so as to avoid damage to the intraventricular structures. At this point, the purse-string was drawn taut about the valvulotome by an assistant and was held snugly

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about the instrument during manipulation. By this means, the procedure was carried out without bleeding. The instrument was advanced in the ventricle toward the aortic valve with one hand, while the index finger of the opposite hand was manipulated beneath the ascending aorta at its most proximal portion so as to lie flush with the aortic ring. Using the latter finger as a guide, it was found that the distal end of the valvulotome could be interposed almost exactly between the three aortic valvular leaflets. When its position was determined with relative certainty the barbed blade was projected forward so as to lie astride the free margin of a valvular leaflet and the instrument then was withdrawn proximally into the ventricular chamber thus dividing the aortic cusp (Fig 3). After division of the cusp which was denoted in most instances by the immediate appearance of a thrill detected by the palpating finger at the aortic ring, the valvulotome was withdrawn from the ventricle with the blade pulled back into the sheath. Upon removal of the instrument the ends of the purse-string suture were tied by the assistant thus closing securely the ventricular incision without hemorrhage. The thorax was closed after inflation of the lung.

RESULTS OF THE TRANSAORTIC METHOD

The observations recorded herein pertain to a total of 37 animals subjected to operation by a transaortic approach. The data concern operative mortality and gross and microscopic findings as regards the valvular lesions and the aortic wounds through which the valvulotome was passed. Animals were sacrificed at intervals varying from 24 hours to 18 days after operation.

Mortality. Of 22 animals previously reported (7) attempts at closure of the aortic wound after withdrawal of the valvulotome were made in 7 animals by direct suture of the defect. The results were unsatisfactory inasmuch as severe hemorrhage occurred accounting for the operative death of 5 of the 7 animals so treated. In the remaining 15 the aortic wound was closed by tamponade with a gelatin sponge held in place by stay sutures in the periaortic fat with only 3 operative deaths. The mortality for the group was 36 per cent.

TABLE I.—ANALYSIS OF OPERATIVE DEATHS.
TRANSAORTIC METHOD

	Number of animals	Deaths	Mortality per cent
Aortic suture technique	7	5	71
Gelatin sponge technique	5	5	100
Oxidized cellulose technique	2*	0*	0*
Periaortic fat suture alone	5	3	60
Totals	17	13	76

*Operative survival; death from secondary postoperative hemorrhage.

The same technique was applied to a second group of 15 animals; there were 2 operative deaths due to uncontrollable hemorrhage from the aorta, a mortality of 13 per cent. In the surviving animals a gelatin sponge was used at operation in 8, oxidized cellulose in 2, while in 3 a purse-string suture in the periaortic fat was tied snugly over the aortic opening without the use of an underlying hemostatic agent to tamponade the aortic wound.

Recapitulation of these figures reveals that the total operative mortality in 37 animals subjected to transaortic valvulotomy was 76 per cent (Table I). This excessive figure is due obviously to the loss of 5 animals subjected to direct closure of the aortic wound. Of the remaining animals treated by methods other than aortic suture, there were 5 operative deaths in 30 subjects, a mortality of 17 per cent.

In addition to the operative deaths, 3 animals died of secondary hemorrhage from the aortic wound on the third postoperative day. In each instance oxidized cellulose was the hemostatic agent used to tamponade the aortic opening. It is significant that secondary hemorrhage did not occur in any instance in which a gelatin sponge or periaortic fat sutures alone were used.

Gross findings. At the time the animals were sacrificed, gross examination concerned the appearance of the aortic wound and the type of valvular lesion produced. Wide variation in the size and persistence of the aortic opening was noted. In the 27 animals surviving the operation, the aortic opening was found to be either healed completely or of very small size in 7, persistent and of large extent (greater than the original size) in 12 of

TABLE II—VALVULAR LESIONS PRODUCED BY TRANSAORTIC METHOD IN SURVIVING ANIMALS

Type of lesion (Fig.)	Number of animals	Incidence per cent
Perforation	3	30
Laceration	6	
Avulsion	4	5
Division	6	
Absence of lesions	3	
Totals	27	100

approximately the original dimensions in 8. The time elapsing between operation and autopsy seemed to have little effect, complete closure of the wound being found in some after 72 hours on the one hand, persistence of a large defect after 16 days on the other. Of striking significance is the fact that there was no instance of extensive extravasation of blood into the periaortic tissues and no evidence of aneurysm in those animals treated by the gelatin sponge technique or by periaortic fat suture alone, this being the case despite persistence of the opening on the intimal surface. In the 2 cases in which absorbable cellulose was used massive secondary hemorrhage occurred, resulting in death of the animals through a "blowout" in the periaortic fat on the third postoperative day. In each there was found at autopsy a widely patent communication between the aorta and the pleural cavity.

Although persistence of the aortic opening on the intimal surface was present in 20 animals sacrificed from 3 to 18 days after operation, thrombus formation was noted in only 1 case. This animal was sacrificed on the fifth postoperative day. A large rent in the intimal surface of the aorta was present but was effectively sealed off from the periaortic structures by the overlying gelatin sponge and its anchoring periaortic fat. Protruding from the intimal defect was an elongated thrombus, the unattached end of which was hanging free in the aortic lumen; the clot measured 2.5 centimeters in length and 0.5 centimeter in width. Evidence of embolic phenomena was not found. A second animal sacrificed on the seventh postoperative day was found to have an unusually large rent in the intimal surface of the aorta through which a segment of the

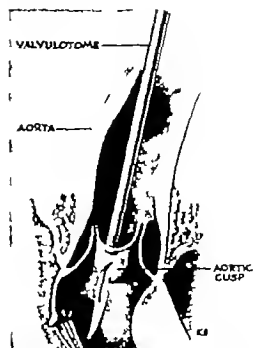


Fig. 1. Transaortic method of valvulotomy.

overlying gelatin sponge protruded into the aortic lumen. Despite the presence of a foreign body anchored within the vascular stream, a thrombus was not found at autopsy and no evidence of embolic phenomena was detected.

The valvular lesions produced by the transaortic approach are denoted in Figure 2, showing a considerable variation in the type of defect occurring in the affected leaflets. Similarly, the resulting auscultatory murmurs assumed either a systolic or diastolic character according to the extent of valvular division. Of the 27 animals surviving operation, the aortic valve showed no evidence of a lesion in 3, which was due probably to failure of the valvulotome to become engaged in a cusp passing instead into the chamber of the ventricle during systole. This represents an operative failure of 11 per cent (Table II). In the remaining 4 animals, the lesions consisted of valvular perforation, laceration, partial avulsion or division (Table II). A perforative defect was noted in 30 per cent (Fig. 2 a and b), some variety of laceration in 22 per cent (Fig. 2 c and d), partial avulsion in 15 per cent (Fig. 2 e) while extensive division of a leaflet was accomplished in 6 animals or 22 per cent (Figure 2 f and g). Postoperatively auscultatory murmurs were demonstrable in each in

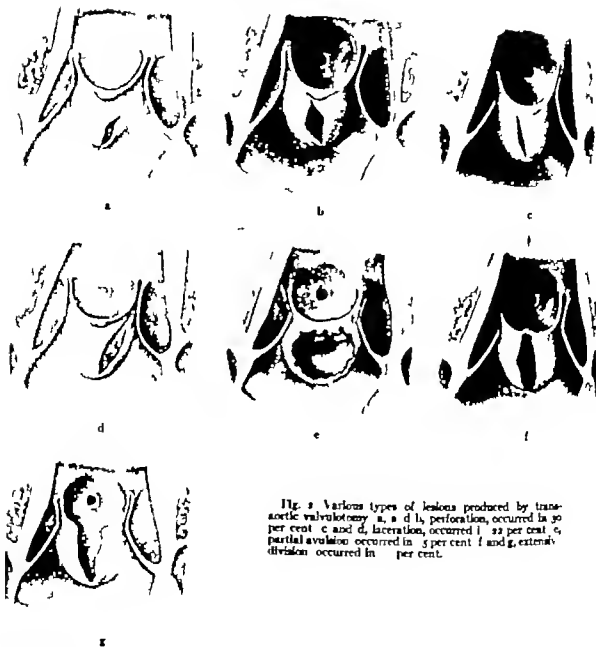


Fig. 2. Various types of lesions produced by trans-aortic valvulotomy: a, a d 1, perforation, occurred in 30 per cent; c and d, laceration, occurred in 22 per cent; e, partial avulsion occurred in 5 per cent; f and g, extensive division occurred in 15 per cent.

stance in which a lesion was produced. A soft blowing diastolic murmur typical of aortic regurgitation occurred in those animals in which division or partial avulsion of a cusp had been accomplished. In the group showing perforation or short laceration of the leaflets, a harsh systolic murmur was demonstrable.

Microscopic findings—aorta The size of the healing aortic wounds through which the valvulotome was passed varied considerably

The manner of healing was essentially the same in all defects which closed successfully and consisted of fibrous tissue proliferation between the divided edges of the aortic wound. The proliferating fibroblastic elements were derived almost exclusively from the adventitial coat and there was little participation by elements of the media and none by the intima except for the lining endothelium. There was no attempt at regeneration by the musculo-



Fig. 3. Transventricular method of valvulotomy a, and lesion of extensive valvular division b produced in majority of animals.

elastic elements of the media but some of the intervening fibrous tissue contributed to closure of the defect. In relatively few instances the divided edges of the aortic wound remained in close approximation and the narrow defect was completely filled with actively growing fibroblasts (Fig. 4). In the majority of instances there was outpouching of the aortic wall at the site of the operative wound. The aneurysmal pouch involved the adventitia and periaortic fibroadipose tissue. Figures 5 and 6 illustrate extension of the endothelialized defect into the adventitial coat with failure of elastic tissue regeneration from the lateral margins. Complete endothelialization of the aneurysmal sac as noted in the latter illustrations occurred as early as 14 days. Figure 7 depicts in detail the endothelial regeneration within the aneurysmal sac. Outpouching into the substance of the wall of the aorta occurred in some cases regardless of tamponade of the aortic opening with a gelatin sponge or closure of the defect by suture of the overlying fat without a sponge.

Microscopic findings—*aortic valves* Division of a valve leaflet produced in the initial phase edema interstitial hemorrhage loss of endothelium along the divided margins and variable degrees of actual necrosis in the area of division.

There was in general during the first 3 to 5 days no leucocytic reaction. Fibrin deposits on the severed margins of the cusps

occurred within 3 days after division and persisted for as long as 14 days. The fibrin was invaded early by fibroblasts (Figs. 8 and 9) and was completely replaced by collagenous fibrous tissue as early as 14 days in some animals. Endothelialization occurred concomitantly with the fibrous organization. The edges of the incised leaflets did not show appreciable distortion but assumed a blunt rounded or club-like shape. None of the healing valves showed any evidence of infection.

RESULTS OF THE TRANSVENTRICULAR METHOD

Fifteen animals were subjected to aortic valvulotomy by a trans-ventricular approach. The results reported herein pertain to the operative mortality of the procedure and to both gross and microscopic changes occurring in the heart and the affected valves. Animals were sacrificed at intervals varying from 3 to 26 days after operation.

Mortality There was 1 operative death in 15 animals undergoing transventricular valvulotomy a mortality of 7 per cent (Table III). Death was due to acute dilatation of the left side of the heart occurring immediately after complete division of an aortic leaflet. A second animal died of empyema and acute purulent pericarditis on the seventh postoperative day. All other subjects recovered without infection and remained well until sacrificed.

Gross findings Certain changes occurring during operation were significant particularly

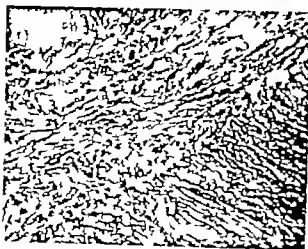


Fig. 4 Aortic wound at 80 days shows complete filling with vascularized fibrous tissue. (Hematoxylin and eosin stain, $\times 80$)

the varying degrees of cardiac dilatation detectable grossly which were noted immediately after division of an aortic leaflet. Since the valvular lesions produced by the transventricular approach were more extensive than those resulting from transaortic valvulotomy a greater degree of aortic regurgitation was effected. The sudden increase in the volume of blood within the left ventricle produced marked dilatation of the left side of the heart in some animals. As noted above acute dilatation was of such degree as to cause death in 1 animal while in 2 others it resulted in complete cessation of both left ventricular and left auricular contractions for approximately 40 seconds the heart gradually regaining its tone and resuming a normal rhythm as it adjusted itself to the increased ventricular output. In the remaining animals, grossly demonstrable dilatation occurred in 8 without cessation of ventricular activity while in 3 dilatation was slight or absent as determined by gross inspection.

Electrocardiographic tracings were made before operation immediately before and after valvulotomy after closure of the thorax

TABLE III.—MORTALITY TRANSVENTRICULAR METHOD

Number of animals
Survivals
Operative deaths
Mortality per cent

5
4
7



Fig. 5 Aneurysmal defect of aortic at 7 days after closure with gelatin sponge. Note nearly complete calcification. (Hematoxylin and eosin, $\times 25$).

and shortly before the subjects were sacrificed. All tracings were taken while the animals were under sodium pentobarbital anesthesia. Lead II only was used throughout the experiments. In approximately two-thirds of the animals, rather marked disturbances of rhythm were noted during manipulation of the heart incident to placing the purse-string suture in the apex and during insertion of the valvulotome. The other one-third of the group showed surprisingly little interference with cardiac rhythm. In some subjects an inverted T wave was noted prior to operation, but a constant finding in all animals was inversion of the T wave after closure of the wound, due presumably to myocardial damage inflicted by entering the ventricle and by tying the purse string suture. Tracings made after the fourteenth postoperative day showed return of the T wave to a normal curve. Figure 10



Fig. 6. Aneurysmal defect of aortic wall 14 days after closure of periaortic fat without gelatin sponge repair showing complete endothelialization without elastic tissue repair. Note advanced fibrous organization of adventitial base of defect. (Van Gieson-elastic tissue stain $\times 20$)



Fig. 7. High-power view at 14 days after closure of endothelial cell layer overlying fibrous base of aneurysmal sac which is shown in Figure 6 (Hematoxylin and eosin. $\times 570$)

c and d shows the typical postoperative T wave changes both elevation of the S-T segment and inversion of T being present but there is no disturbance of rhythm. Figures 11 and 12 on the other hand, illustrate marked irregularity of rhythm. In the former are noted short runs of ventricular ectopic beats immediately after valvulotomy had been accomplished (Figure 11 c) with return to a normal rhythm after closure of the thorax (Figure 11 d). In Figure 12 c illustrates a disorganized rhythm with probable ventricu-

lar fibrillation which occurred during manipulation of the heart preparatory to placing the apical purse-string suture while Figure 12 d shows ventricular tachycardia which accompanied tying of the suture immediately after valvulotomy had been effected. Figure 12 e and Figure 12 f are tracings made shortly before and after closure of the thorax respectively, illustrating the prompt return of normal rhythm after manipulation of the heart had been discontinued. Disappearance of arrhythmias after cardiac manipulation had been



Fig. 8. Edge of valvular defect at 3 days showing edema and fibrin deposit with early fibroblastic invasion. (Hematoxylin and eosin $\times 65$.)



Fig. 9. Edge of valvular defect at 7 days showing more advanced fibroblastic organization of fibrin and beginning endothelialization. (Hematoxylin and eosin stain $\times 65$.)

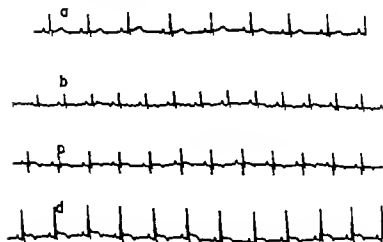


Fig. 3a. Electrocardiographic tracings, Lead II. a, Preoperative control; b, open thorax control without manipulation of heart; c, immediately after valvulotomy showing regular rhythm; d, after closure of thorax, showing typical postoperative changes (elevation of S-T segment and inversion of T with regular rhythm).

concluded was noted uniformly in each instance.

The valvular defects produced by the ventricular approach were similar in type, either complete or partial division of a leaflet being accomplished in each of the 14 surviving animals (Table IV). Figure 3a denotes the lesion of complete division which occurred in 64 per cent of the animals; the remaining 36 per cent showed incomplete division of a leaflet but in each instance of sufficient degree to

produce definite aortic regurgitation. The resulting auscultatory murmurs were diastolic in character in most instances typical of those heard in clinical aortic regurgitation. Gross defects of the borders of the divided leaflets were smooth and showed no tendency toward healing. The formation of vegetative thrombi on the defects did not occur in any instance.

At the point through which the valvulotomy was passed into the ventricular chamber there was found to be considerable induration



Fig. 3b. Electrocardiographic tracings, Lead II. a, Preoperative control (note inversion of T); b, open thorax control; c, immediately after valvulotomy showing runs of

ventricular ectopic beats; d, after closure of thorax showing depression of S-T segment and inverted T with resumption of normal rhythm.

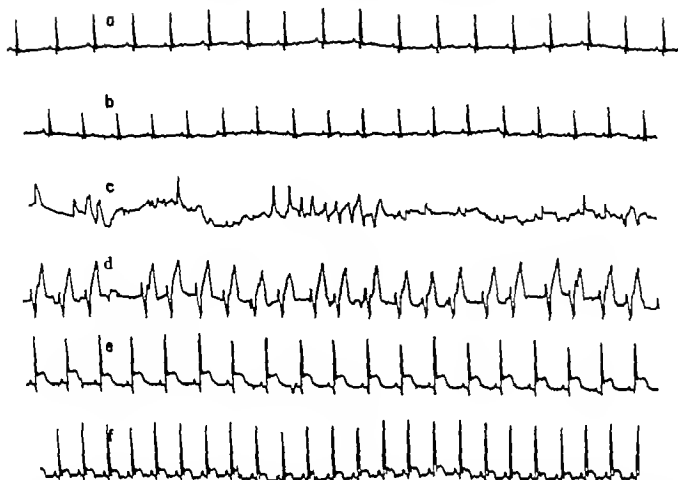


Fig. 12. Electrocardiographic tracings, Lead II. a, Preoperative control (note inversion of T). b, open thorax control without manipulation of heart. c, during manipulation of heart showing disorganization of rhythm with probable ventricular fibrillation. d, during manipulation of heart

showing ventricular tachycardia. e, immediately after valvulotomy showing elevation of S-T segment with resumption of regular rhythm. f, after closure of thorax showing usual T wave changes.

of the myocardium about the purse string suture of catgut as late as 20 days after operation. However the endocardium appeared smooth and thrombus formation was found in only one instance. The latter occurred in an animal dying on the seventh postoperative day of acute empyema and suppurative pericarditis and consisted of a small fibrinous plaque attached firmly to the endocardial surface of the ventricular wound.

Microscopic findings—myocardium of left ventricle. The myocardium through which the valvulotome was passed showed varying evidence of necrosis inflammatory reaction and healing. The changes were essentially those of a healing infarct. In some animals tissue reaction was minimal after 25 days and consisted of fibrous scarring with little destruction of the myocardium. In others however iso-

lated areas of myocardial necrosis were noted as late as 25 days, with retardation of the normal healing process. In these instances, the islands of necrotic muscle were demarcated by peripheral fibrosis which was believed to produce local ischemia. There were no instances of endocardial thrombus formation with the exception of one animal having empyema and

TABLE IV—VALVULAR LESIONS PRODUCED IN SURVIVING ANIMALS TRANSVENTRICULAR APPROACH

Type of lesion	Number of animals	Incidence per cent
Complete division	9	64
Incomplete division	5	36
Absence of lesion		
Totals	14	100

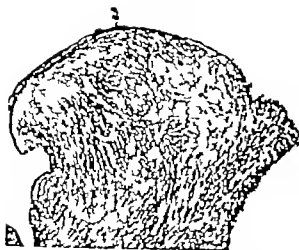


Fig. 3 Margin of divided leaflet at 4 days showing complete endothelialization (Hematoxylin and eosin. $\times 65$)

pericarditis noted above and no evidence of cardiac aneurysm at the site of the ventricular wound.

*Microscopic findings—*aortic valves The histologic changes in the aortic leaflets were the same as those which occurred when the transaortic approach was used. Endothelialization of the margins of the divided cusps was found to be complete as early as 14 days (Fig. 13).

The lack of marked deformity, absence of vegetations and the fibrous repair and endothelialization of divided cusps are shown in Figure 13.

COMMENT

The need for a safe technical approach to the surgical treatment of chronic valvular disease of the heart has been recognized for many years. Recent developments in cardiac surgery, notably the splendid contributions of Blalock in pulmonic stenosis, have created a stimulus for reinvestigation of the problem. The idea is not new. The surgical treatment of mitral stenosis was suggested by Brunton in 1902. Following animal experimentation it was attempted clinically by Cutler and his associates (4) in 1924. In 1929 Cutler and Beck (3) summarized their personal experiences in the surgical treatment of 8 cases of mitral stenosis and added 4 collected cases of chronic valvular disease subjected to operation. The mortality for the entire group was

83 per cent. Since these patients were treated much progress has been made in thoracic surgery and particularly in the administration of positive pressure inhalation anesthesia. These advances, combined with recent developments in chemotherapy and a sound present-day concept of the prevention and treatment of shock, minimize many of the former hazards and should permit recognition of Cutler's methods with significant reduction in mortality.

In comparing the two experimental techniques reported herein with a view toward their application to human subjects, certain considerations are immediately obvious. First it seems clear that transaortic valvulotomy is an impractical method. The possibility of clinical application is rendered unlikely because of the high mortality incident to technical difficulties in controlling hemorrhage, the uncertainty of producing an adequate valvular lesion (Table II) and microscopic evidence of the probability of later aneurysm formation. On the other hand, transventricular valvulotomy was performed with technical simplicity with an operative mortality of only 7 per cent and with the production of uniformly satisfactory valvular lesions. On the basis of these factors alone the superiority of the ventricular approach is self-evident. Furthermore, the latter method is applicable theoretically to clinical mitral stenosis as well as to aortic stenosis.

A second consideration in the possible application of transventricular valvulotomy to clinical aortic and mitral stenosis concerns the type of operative correction contemplated. It would seem that simple incision of a heavily scarred (and often calcified) aortic or mitral valve would afford an inadequate means of increasing the size of the narrowed orifice. It is likely also that an incised wound in the fibrous valvular ring would heal eventually. With these considerations in mind, actual removal of a segment of the thickened valvular ring (partial valvulectomy) would appear preferable to simple incision or division of the stenotic valvular orifice (valvulotomy). The valvulotome used in the experiments herein described would be therefore unsuitable in human subjects. The development of a suit-

able instrument designed to remove a segment of a fibrotic or calcified ring between strong biting surfaces is now in progress. Such an instrument should be of the smallest diameter compatible with an effective biting mechanism in order that the extent of damage sustained by the ventricular wall may be minimized as much as possible.

A third factor of importance is the disturbance in cardiac rhythm which was demonstrable in some animals (Figs 11 c and 12, c d) during manipulation of the valvulotome. Clinically it is obviously inadvisable to induce ventricular fibrillation and tachycardia during operation in a patient having myocardial damage. The preoperative systemic administration of quinidine sulfate or the topical application during operation of procaine, as reported by Mautz, should minimize or possibly eliminate some of the more serious arrhythmias.

The final consideration of significance concerns the advisability of converting a stenosis into a regurgitation. Regarding the mitral valve it is generally agreed that stenosis is a much more serious lesion than regurgitation causing marked restriction of the patient's activities and affording a poor prognosis. This may not be the case however in lesions of the aortic valve. There is a group of patients not withstanding, in the young adult range of years having aortic stenosis of sufficiently advanced degree to interfere substantially with their activities. The difficulties of these individuals are largely mechanical in origin and consist of inadequate left ventricular output which produces chronic hypoxia becoming

acute during exertion, persistently low systolic blood pressure and decreased coronary blood flow all of which are the result of a small, contracted aortic valvular orifice. Improvement in each of these factors could be logically anticipated by increasing the size of the valvular orifice to permit a greater ventricular output. In our present state of experimentation however one can only speculate upon the relative effects either beneficial or harmful of aortic regurgitation and aortic stenosis, inasmuch as a satisfactory method of producing experimental aortic stenosis is lacking. The work of Shaw and his associates is a valuable contribution in the study of experimental valvular lesions other than those of the aortic valve.

SUMMARY

The technique of aortic valvulotomy in dogs by a transaortic and transventricular approach is described and a comparison of the results of the two procedures is presented. Certain considerations in the possible application of the experimental methods to clinical valvular disease of the heart are discussed.

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STUDIES ON VAGOTOMY IN THE TREATMENT OF PEPTIC ULCER

II Clinical Evaluation

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THE history of vagotomy and its early use in man as a treatment for peptic ulcer has been reviewed previously (32-34). Clinical experience with partial vagotomy and experimental evidence show that incomplete vagotomy is of little if any value in the treatment of peptic ulcer. Most of the early workers in this field used surgical procedures which resulted in only partial vagus section. Dragstedt, who has suggested complete vagotomy as a treatment for peptic ulcer, has reported favorable results (7-11, 38) and has created a widespread interest and controversy in the subject.

In June of 1946 a study of vagotomy in the treatment of peptic ulcer was started at the Cook County Hospital on the surgical service of the senior author. During the following year vagus section was performed on 35 patients with peptic ulcer.

SELECTION OF CASES

Patients demonstrating very severe ulcer diathesis were selected for this study. In all 35 cases previous medical or surgical management had failed to give relief from pain. The indications for surgery were based on prolonged periods of ulcer symptoms with one or more complications (Table I).

The duration of symptoms ranged from 1 to 36 years with an average of 11 years. There were 16 instances of previous perforation, 19 patients had had previous bleeding, 10 of whom had had massive hemorrhage, and 6 patients had pyloric obstruction which in 3 patients, was complete. Repeated attacks of severe epigastric pain were present in 31 of the 35 patients and in 12 the pain was intractable.

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Duodenal ulcer was present in 26 patients, marginal ulcer in 3 patients following gastroenterostomy, marginal ulcer in 4 patients following gastric resection, and 1 patient had a gastrojejunal colic fistula following gastric resection (Table II). One patient had a pyloric ulcer shown to be benign by biopsy at the time of closure of a perforation 2 months before vagus section. This was the only gastric ulcer in the series.

SURGICAL APPROACH

The transthoracic approach as described by Dragstedt (10) was employed in the first cases. A 2 to 3 centimeter portion of the nerve was resected at approximately 6 centimeters above the diaphragm. No attempt was made, however, to remove the distal branches of the vagi extending to or below the diaphragm as described by Dragstedt and Moore (35).

The transabdominal approach as described by Dragstedt (7) has been employed in the remaining 26 cases and is preferred since:

1. Exploration of the gastrointestinal tract allows examination of the viscera for confirmation of diagnosis and for other intra-abdominal pathology.

2. The site of the ulcer may be examined, and if marked scarring is present, a simultaneous gastroenterostomy is performed to prevent gastric retention.

3. Patients have a quicker convalescence and less postoperative discomfort.

4. The percentage of patients having incomplete vagotomy will not differ greatly whether the transthoracic or transabdominal method is used, provided that a careful search is made for all vagus fibers in the region of the diaphragm.

From an anatomical point of view, complete vagotomy can be done most satisfactorily at the diaphragm at which location the smaller branches of the vagi tend to form into large

TABLE I —INDICATIONS FOR VAGOTOMY
(35 CASES)

Complications	No. cases
Previous perforation (with recurrent intractability)	4 (16 perfora- tions)
Bleeding (including 10 cases of previous massive hemorrhage)	9
Pyloric obstruction	6
Intractable pain	
Total	22

More than 1 complication was present in some patients.

trunks (3, 5, 24). Due to marked anatomical variation in the distribution of the nerves complete vagus section may be difficult to achieve in about 8 per cent of cases (3).

POSTOPERATIVE CARE

Early in this study postoperative intra gastric suction was maintained for 2 to 3 days. Following a case of acute gastric dilatation and retention the gastric decompression was continued for 5 days in order to prevent the marked gastric dilatation which often followed vagus section. The patients were kept in fluid electrolyte and nitrogen balance by parenteral administration of saline, dextrose, protein digests and blood. The patients were usually out of bed the day after surgery and ambulatory by the second day. Small frequent feedings of clear liquids were given on the sixth and seventh postoperative days and small frequent feedings of general liquids on the 2 following days. A soft diet was usually given on the tenth postoperative day and a general diet was allowed after 2 to 3 weeks. The patients were permitted to eat anything they chose but were cautioned against overeating for the first few months because of the danger of producing an



Fig. 1. Barium meal demonstrating cardiospasm, gastric dilatation and retention 2 weeks following vagotomy.

acute dilatation in the vagotomized stomach. There were no further cases of acute gastric retention and dilatation.

RESULTS

In general, clinical results have been excellent. Following surgery all patients had immediate relief of ulcer pain. For the first time in many years 31 of the 35 patients are leading an unrestricted life. Ulcer management including dietary and medical treatment has been eliminated completely. Following vagotomy the majority of the patients noted a change in the bowel habit. They had one or two soft bowel movements a day whereas preoperatively almost every patient gave a history of constipation. Troublesome diarrhea occurred in 2 patients. However the diarrhea disappeared spontaneously after 2 months. Thirty patients had satisfactory weight gain. Thirty-one patients expressed themselves as being

TABLE II —TYPE OF SURGERY IN 35
CASES OF VAGOTOMY

Type of surgery	Diagnosis	N. of Cases	Total
Transthoracic vagotomy	Duodenal ulcer	6	9
	Marginal ulcer	3	
Transabdominal vagotomy	Duodenal ulcer	4	9
	Marginal ulcer	5	
Transabdominal vagotomy with posterior gastroenterostomy	Prepyloric ulcer		7
	Duodenal ulcer	6	

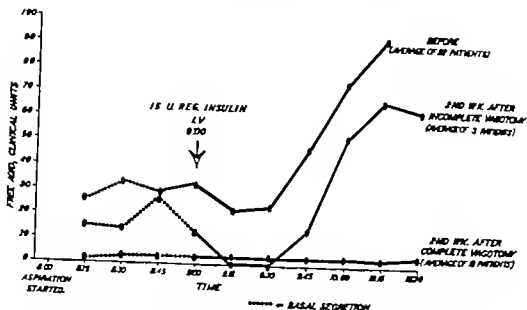


Fig. 2 The effect of insulin on gastric acidity before and after vagotomy

well satisfied with the results. The most striking results from the standpoint of relief of intractable ulcer pain have occurred in 8 patients with marginal ulcer.

One patient died on the eighth postoperative day due to uremia and lower nephron nephrosis which followed a blood transfusion reaction. Recurrence of ulcer symptoms with positive x-ray evidence of peptic ulcer occurred in 4 cases. One patient developed an acute gastric retention and dilatation on the tenth postoperative day which was treated effectively by gastric lavage followed by the administration of doryl (carbamylcholine 36). The initial

dose of doryl was 0.25 milligram subcutaneously followed by 2.0 to 4.0 milligrams orally 3 times a day before meals. This patient developed a persistent foul belching which lasted 5 months in spite of treatment with doryl or urecholine (10 mgm. 3 times a day before meals). These foul eructations have ceased and the patient is entirely asymptomatic.

The symptoms of cardiospasm verified roentgenologically in 2 instances (Fig. 1) were noted in 3 patients about 3 weeks postoperatively. The dysphagia, substernal discomfort, and regurgitation of food were spontaneously relieved in from 1 to 3 weeks.

One patient has a loss of appetite with a failure to gain weight and 1 patient has occasional vomiting. One patient who had an

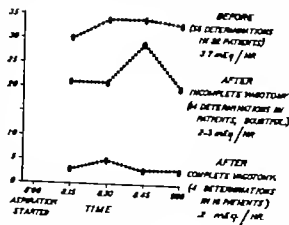


Fig. 3. Average basal secretion before and after vagotomy 6 hours previous fasting)

TABLE III.—12 HOUR NIGHT SECRETION BEFORE AND AFTER VAGOTOMY

	Volume cubic centimeters	Free acid clinical units	No. of determinations	No. of patients
Preoperative	1153	30	79	13
Postoperative				
a. Complete vagotomy with gastroenterostomy	630	3	13	4
Without gastroenterostomy	343		3	
b. Incomplete vagotomy	687	16	19	1

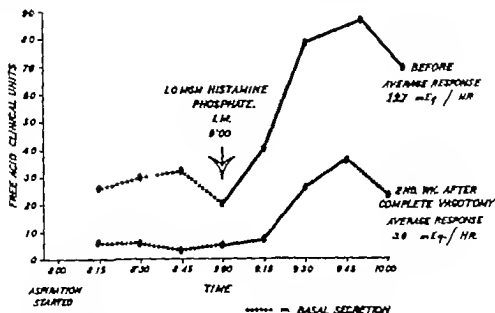


Fig. 4. The effect of histamine on gastric acidity before and after vagotomy (average of 11 patients)

excellent clinical result, was readmitted to the hospital 3 months following vagotomy with a bronchopneumonia from which he died. Autopsy showed the pneumonia to be unrelated to the previous vagotomy.

The most frequent and disturbing complication was gastric retention and distention but this has been controlled by the use of a gastroenterostomy if pyloric obstruction was present by careful postoperative management and by occasional use of doryl or urecholine (36).

Thirty patients were tested for completeness of vagotomy by the insulin test (34). Fourteen to 16 units of regular insulin were injected intravenously after a 1 hour control period of basal secretion and motility. The effect of insulin hypoglycemia on gastric secretion and

motility was noted for $1\frac{1}{2}$ to 2 hours. The average preoperative and postoperative results in 22 patients with duodenal ulcer are shown in Figure 2. Preoperatively there was a marked rise of the free acid level following insulin hypoglycemia and spontaneous or insulin induced hunger contractions were present in the fundus of the stomach. A similar response postoperatively is positive evidence of incomplete vagotomy whereas the absence of an acid response to insulin hypoglycemia and of hunger contractions either spontaneous or insulin induced, is indicative of complete vagotomy. Of 30 patients tested 5 had incomplete vagus section in that the result was doubtful, and 1 had recurrence of vagal function after 9 months a total of 8 patients having

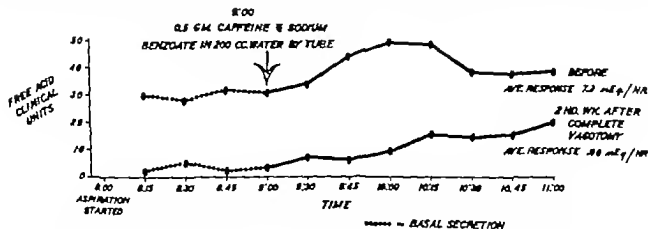


Fig. 5. The effect of caffeine on gastric acidity before and after vagotomy (average of 12 patients)

doubtful or incomplete vagotomy. Four of these have had recurrence of ulcer symptoms.

Roentgenologic studies were made preoperatively 2 weeks postoperatively and again at 2 to 9 months after surgery (33). Two weeks after complete vagotomy there was a marked delay in the initial gastric emptying. After 4 hours there was 50 to 70 per cent retention of barium in the stomach and in only a few cases had the barium reached the cecum. No strong peristaltic waves were seen in the stomach. Gastric retention was present in patients without gastroenterostomy and in those with a large gastroenterostomy but was less in the latter group. Marked contractions of the stomach and prompt gastric emptying were noted 5 to 10 minutes following the administration of 0.25 milligram of doryl subcutaneously (36). Delay in gastric emptying was less marked after 3 months however it was still present 9 months following complete vagotomy.

Physiologic studies show marked changes in gastric function following complete vagotomy (35). The night secretion is markedly reduced (Table III). The basal secretion after 16 hours of fasting is practically eliminated (Fig. 3). The secretory response to histamine is reduced from 12.7 to 3.6 milliequivalents per hour or 72 per cent (Fig. 4). The secretory response to caffeine is reduced from 7.2 to 0.96 milliequivalents per hour or 86 per cent (Fig. 5). Spontaneous type I, II and III hunger contractions after 16 to 24 hours of fasting are not present in the fundus of the stomach up to 9 months after complete vagus section.

DISCUSSION

The early complications of vagotomy such as cardiospasm, gastric dilatation or retention are easily controlled and do not detract from the value of vagotomy in the treatment of peptic ulcer. There are two important questions, however, which must be answered before vagotomy can be accepted unreservedly.

1. What percentage of patients will have recurrence over a period of years?
2. Are the changes in gastric function permanent following complete vagotomy? If so will there be late sequelae due to either changes in gastric function or to changes in other organs innervated by the vagi?

Theoretically recurrence may be explained by either failure to resect all the vagus fibers, regeneration of the vagi or by factors unrelated to vagus nerve section. Since section of all the vagus nerve fibers going to the stomach is necessary in order to obtain a good result in the treatment of peptic ulcer a determination of completeness of vagotomy should be conducted on all patients. This can best be ascertained by use of the insulin test (34). Most of the clinical reports on vagotomy do not specify the number of patients having had incomplete vagus section. One clinic reports that 48 per cent of patients had incomplete vagus section (17). In our series, 5 of 35 patients, or 14 per cent, had incomplete vagotomy postoperatively as shown by the insulin test. In 1 case which tested complete following surgery there was a mild recurrence of ulcer distress after 9 months. An insulin test at this time showed incomplete vagotomy. This may have been due to regeneration of the vagus nerve fibers. Thus, at the end of a year 6 patients, or 17 per cent, were known to have incomplete vagus section. Four of these have had recurrence of ulcer distress. One had a very severe recurrence of epigastric distress, hematemesis, and vomiting 6 months after incomplete trans-thoracic vagotomy for a marginal ulcer. The patient was reoperated upon and a transabdominal vagotomy performed which subsequently tested complete. The patient has had an excellent clinical result to date.

Gastroenterostomy has a very limited place in the treatment of peptic ulcer because of the high incidence of postoperative gastrojejunal ulcer. Incomplete vagotomy and gastroenterostomy may result in similar gastrojejunal ulceration.

The permanency of the altered gastric function following complete vagotomy is not yet certain. The early changes in gastric function provide evidence for a reappraisal of the present concept concerning the relationship of the vagus nerves to gastric function. Pavlov proved that the vagi are the sole mediators of the cephalic phase of gastric secretion. The vagi are the predominating but not the only factor contributing to the interdigestive period of gastric secretion as shown by the reduction but not complete abolition of the night and

basal secretion following complete vagotomy. Also the gastric response to secretagogues is partially dependent upon vagus function as shown by decreased gastric response to caffeine and histamine after complete vagotomy.

Illustrative of the change in the gastric secretory mechanism following complete vagotomy is a patient who prior to surgery, had spontaneous secretion of free acid up to 78 clinical units during the basal period and 135 clinical units following 10 milligram of histamine phosphate. After complete vagotomy there was no free acid during the periods of basal secretion or following histamine. An achlorhydria was present.

In view of these changes in gastric function following vagotomy one must consider the possibility that the other organs innervated by the vagus will also be affected. The influence of complete vagotomy on the pancreas, liver, gall bladder, intestines, adrenals and kidneys has not been reported. One possible instance of an exacerbation of hypertension following vagotomy is reported (26).

In spite of lack of information concerning recurrences and late sequelae, complete vagotomy is considered the treatment of choice for marginal ulcer following gastric resection.

SUMMARY AND CONCLUSIONS

Thirty five patients with peptic ulcer have had vagus section and have been followed clinically from 6 to 15 months. Complete vagotomy causes immediate cessation of peptic ulcer distress with apparent healing of the ulcer. There are marked changes in gastric secretory and motor mechanisms following complete vagotomy. It is not certain to what extent the altered gastric function is permanent. Little is known of the effect of vagotomy on the other organs innervated by the vagi.

It is still too early to make a final evaluation of vagotomy in the treatment of peptic ulcer. Until more information is available concerning the incidence of recurrence of ulcer distress and the possible late sequelae, the use of vagotomy should be limited to clinical investigation with one exception. Complete vagotomy is the method of choice in the treatment of marginal ulcer following gastric resection.

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STEEL WIRE SUTURES LOCAL ANESTHESIA, AND IMMEDIATE AMBULATION IN THE TREATMENT OF HERNIA

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THE advantage of metallic suture material in surgery had been known since Marion Sims successfully closed the first vesicovaginal fistula with silver wire. His success demonstrated that these sutures would be effective where no others would succeed. The use of wire generally was not feasible because of the difficulty in handling the silver wire, its lack of strength and the cost. The introduction of stainless steel wire by Babcock in 1932 and its great success in his hands as well as those of his followers has opened new fields of surgery for us and to our minds marks one of the great surgical advances in years comparable even to chemotherapy. Difficult fistulas and sinuses may be approached with confidence and operations on mucous membranes (i.e. cleft palate etc.) are no longer awesome.

The success of the stainless steel wire suture on the serosa of the bowel and in such areas as duodenal stump closures can be attested by those who have tried it. Not only do structures heal better but the infection incidence is greatly reduced. Jones' reduction in the incidence of infection from 27.5 to 0.85 per cent in large bowel surgery by changing from catgut to steel wire is sufficiently significant in this respect. Since 1935 this suture has replaced all others in abdominal wound closures in our practice. Some surgeons, however, are not aware of its wide adaptability to general surgery. It is the purpose of this paper to show its use in hernia repair where it is of particular value.

Hernia is a common surgical affliction. In the examination of 2,700,000 men 4 per cent of those between the ages of 21 and 30 years were rejected for military service because of hernia. Approximately 10 per cent of all males from the age of 20 to 70 years have a hernia on one side and of these 60 per cent have sufficient findings on the other side as to make them physically disabled. It follows that in

general surgical practice 1 of every 5 or 6 operations will be for this condition.

Surgical cure after operation is somewhat uncertain particularly in the older patients. Most surgeons when questioned will claim a very low recurrence rate but when large series of carefully followed patients are studied an incidence from 10 to 30 per cent is usual. Erdman reported 650 hernias with a recurrence rate of 7 per cent and this favorably compared with the 8 per cent in L. Davis' series of 754 at the Massachusetts General Hospital. If the patient is elderly however the chance of cure after operation is less. Of 659 hernias in patients over 50 years of age operated on at the Ruptured and Crippled Hospital in New York (Hospital for Special Surgery) failure resulted in 25.8 per cent of the operations. In the Grace and Johnson series failure resulted in 30 per cent in the indirect type and in 38 per cent in the direct type. This lack of success in from 10 to 30 per cent of operations for hernia repair carried out by competent surgeons has led to a search for factors other than technique as the cause of failure. Anatomical studies were made to determine if there was a type of physique which made repair impossible. Moorehead was able to observe over a period of years the progress of nearly 100 per cent of his New York subway patients and he reported reoperation in 10 per cent. The Army and Navy where a fair check can be maintained by the health record system also showed a large recurrence rate. At a large Naval hospital where I served on the surgical service 12 per cent of all hernia operations were for recurrence. The average recurrence of direct hernias reported in the literature was 24 per cent.

While technique and skill play a large part in success, a hernia repair can succeed only if the structures remain united until healing is complete. In this respect, suture material plays an important part. Surgeons, in reoperation for

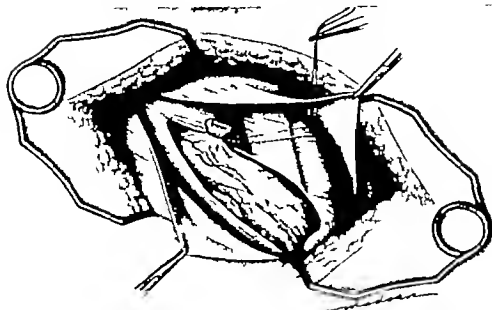


Fig 1. Babcock type hernioplasty. Sac is dissected to internal ring, base is trans-fixed and transplanted behind the lateral edge of rectus muscle. The lateral edge of rectus is united to the shelf of the inguinal ligament medially; the cord is not elevated or disturbed. The external oblique is imbricated. All sutures are of interrupted steel wire.

some complication frequently have noted the complete disintegration of absorbable sutures within a few days time. This inconsistency in the action of catgut stimulated a search for other suture materials. The effort was hastened by the knowledge that certain patients have a catgut allergy, an antipathy which causes them actually to digest and destroy the material when it is in the body. Babcock was among the first to notice and report this manifestation after investigating it for considerable time in 1933. Cumette Kraissal and others proved this allergic factor while Hinton showed that 1 of every 10 patients who has been operated upon was sensitive to an 0.8 per cent solution of fresh sheep gut. When such allergy exists not only is there poor or no wound healing but there is a tendency to wound infections. Whipple was able to reduce this wound infection incidence to one-third merely by discarding catgut. Even when there is not catgut sensitivity, the absorption of the material at the time of greatest activity can be responsible for the weakness in the wound. This thought is further strengthened by the fact that most recurrences are just

above the pubic area, the point of greatest strain. It is fair to assume that the suture material must bear considerable responsibility for the high hernia recurrence rate.

During my 4 years' association with Dr Babcock we were much interested in the suture problem. Under his supervision many experiments with various sutures were made by me and continued by Preston Holland and Large. All types of catgut, silk, linen, cotton, plastic material, and wire were sutured through the skin and observations were made at 5, 7, and 14 days in order to study the effect of the material in human subjects. In reoperations pathological sections were made of both the sutures and the surrounding tissues. Control animal experiments for tissue reaction and suture were carried out. Later, I continued these experiments in New York. The results of this work are on record and need only to be mentioned. The following observations were made:

1. In 7 to 14 days there is a distinct tissue reaction to catgut whether of the plain or chromic type, the reaction varying from a flare to a true pustular formation.

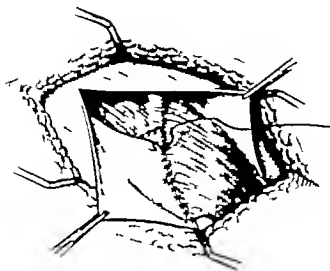


Fig. 2. Modification of Babcock hernia technique with the formation of a new internal ring. The conjoint tendon is incised medially and sewed after the cord is displaced in that direction. The lateral edge of the rectus is united to the sheath of the inguinal ligament. All sutures are of interrupted steel wire.

2. In 50 per cent of silk sutures retained over 10 days some necrosis of tissue occurred around the suture.

3. Cotton sutures while having less reaction than silk are of inconsistent tensile strength sutures on the same spool varying at times as much as 5 pounds in the force they withstand.

4. Wire sutures if not tied too tightly (to constrict tissue) will have no reaction around them 90 per cent of the time.

5. Wire for its size has the greatest tensile strength and therefore can be used in proportionately smaller sizes.

After considerable study and further testing wire was adopted first by Dr. Babcock therefore at the Babcock clinic as early as 1933 and in my own practice since 1935 it has been used exclusively to close all abdominal wounds.

During the recent war while serving in the Pacific area with the Navy I carried several spools of Babcock wire constantly with me since many areas were not supplied with the suture. I am certain that some unexpected good results in infected wounds were brought about through the employment of the wire

suturing material. I refer particularly, to certain intestinal anastomoses and exteriorization operations in the presence of grossly infected wound conditions in which results were far better than would have been expected had other suture techniques been used.

In 1942 I presented a series of 85 consecutive cases of inguinal hernias which were repaired with steel wire at the N. Y. Post Graduate Hospital. During my service in the Navy it was possible to observe the results of repairs with many different suture materials, the type varying usually with the preference of the chief of surgery. When I returned to this country all hernia operations performed at the second largest Navy hospital in this country the one at St. Albans, were done with the steel wire technique. Approximately 60 hernia operations were done every month. A comparison of these operations with those done by other techniques has been made by Ferguson and Fraser. I wish to report only on those performed by me or under my personal direction before, during and since the war.

All of these operations were done under local infiltration and block anesthesia (1 per

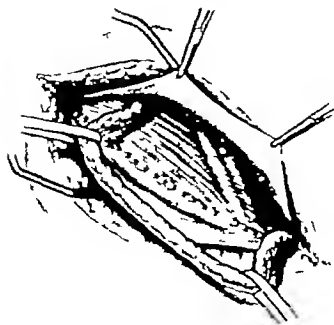


Fig. 3. Modified Bassini repair. The cord is elevated, the sac is resected at the base, and the base is transplanted under the edge of the rectus. A new internal ring is established by dividing the conjoint tendon and moving the cord medially. All sutures are of interrupted steel wire. The external oblique may be sutured above or below the cord.

cent procaine) except the recurrent ones these being done under spinal anesthesia. Three hundred and seventy six hernia operations are thus included with the other I previously reported all performed with the same wire technique. Fifty-eight per cent of these were indirect, 21 per cent direct, 12 per cent recurrent and 9 per cent femoral or umbilical type. The first 143 and the last 70 of these operations were done with a modified Babcock technique. In the Babcock type of operation the cord is not elevated or disturbed. The sac is freed and resected at the internal ring and its base is transplanted behind the lateral edge of the rectus muscle No. 36 steel wire being used (Fig. 1). If the internal ring is very large we have modified this technique by incising the conjoint tendon medially and pushing the cord in that direction and sewing the conjoint tendon below the cord thus making a new internal ring and closing the old one completely (Fig. 2). The repair then follows with the lateral edge of the rectus being sutured with No. 32 or No. 34 wire to the iliopectineus or actually to the peritoneum of the pubis. The lateral edge of the rectus then is united to the shelf of the inguinal ligament the

conjoint tendon being folded into the inguinal canal up to the internal ring. Lateral to the internal ring the conjoint tendon is sutured to the shelf. The external oblique fascia is imbricated with No. 35 steel wire and the skin is closed with No. 36 steel wire.

In the remainder of the cases the repairs were of the Bassini type. The change to the Bassini operation was made while I was in the Navy in order to make the operations uniform and thus save confusion among the officers sent to us for surgical training.

The follow up in the first 86 and the last 70 cases (156) is entirely complete and covers periods of from 12 months to 12 years. The follow up in the remainder of the operations (220) performed in the Navy is incomplete but each patient was followed up for 6 months. There have been 4 known hernia recurrences: 1 in a large hernia twice recurrent before where a distressing postoperative cough caused surgical failure within a few days after operation and another in an enormous hernia with stretched out fascial planes repaired by a trainee. Subsequent repair has been successful so far. While all of these patients have not as yet been followed for a sufficiently long

period they have been observed well past the critical first 6 month period. Seventy five per cent of recurrences are demonstrable within 12 months.

Certain other factors are worthy of mention. Formerly in the Navy a routine flat in-bed period of 21 days was a routine procedure after such an operation. In the 6 months prior to the installation of wire suture material in this Navy hospital the bed days averaged from 9 to 13. With the introduction of the wire suture technique and with the use of local anesthesia the patient was encouraged to get up upon his return from the operating room and to go to the head the first day. Previously we had always been afraid to have hernia patients out of bed early. With the use of the wire technique the danger of early ambulation is over. In the group of patients with hernias repaired by the wire technique including the patients with recurrences the average number of days in bed was 3.4 days and 85 per cent of the patients were up the first day. This early ambulation reduces materially the bladder and chest and thrombosis complications. Men were returned to duty in 21 days, and in the Navy that meant full duty including hoisting and carrying their hammocks and seabags.

The lack of physical discomfort after these operations was outstanding. While it is usual to order morphine routinely after hernia operations, a record of this group showed that

there was only one hypodermic of morphine given per each patient in the first 72 hours.

The complications following these operations were comparable to those in any group in which in many instances, the operation was done by a surgeon under training. There were 9 wound hematomas, 12 wound infections, 9 serous pockets, 14 stitch abscesses, 1 atelectasis (after local anesthesia), 5 pneumonias (3 after local and 1 after spinal), 1 coronary occlusion and 1 partial wound separation. There were no genitourinary complications and no thrombosis. There were no deaths in the group.

SUMMARY

1. Recurrence after hernia operations remains high even in the hands of competent surgeons.

2. Of the nonabsorbable suture materials, steel wire to our minds best fulfills the fundamental suture criteria that it be of great tensile strength, cause minimal tissue reaction, and that it can be inserted with little trauma.

3. Over a period of 10 years it has been used exclusively and satisfactorily in hernia repair.

4. The steel wire repair of hernia combined with local anesthesia and early ambulation has resulted in less recurrences, fewer bed and hospital days, and less discomfort and disability to the patient than when repairs were made with other suture material.

above the level of the lesion. The exception of course is the mid or high cervical lesion which so commonly results in early death. It is hardly tenable furthermore that shock can be said to persist for weeks at a time with the patient in good condition save for his paralysis. This interval should be designated as one of *depressed reflex activity*. But all reflex activity is rarely gone. In fact the genital reflexes (active ischiocavernosus and bulbocavernosus muscle reflexes with erection) may appear immediately to be persistent over a long period of time. Erections occurring immediately have been noted in patients with transected or incompletely crushed cords, both in the cervical and thoracic regions and this reflex has been seen to remain active and easily provoked for as long as 4 years after injury. Indeed it is through stimulation of the external genitalia (but not with nocuous stimuli) the perineal skin and the inner surfaces of the thighs that one may first note the onset of the second stage or the state of *heightened reflex activity*. With the beginning of this second phase there appears the early visceral and vasomotor reflex changes and flexion-extension or adduction of parts of the lower extremities. After the first day or two there is frequently though not characteristically an almost normal appearing flexor movement of the toes on plantar stimulation. During this period there is retention of urine and catheter care is necessary. The bowels require enemas but ordinarily automaticity of the bowels if it develops at all will begin at an earlier date than similar function of the bladder. Knee and ankle jerks are absent during the early days after injury. Bladder irrigation and enemas seldom cause flushing, sweating, headache or crampiness in the abdomen before the 4th week has passed. The skin below the level of the lesion becomes quite dry, pale and lifeless especially on the feet and ankles and tissue turgor is poor. It is during these first few weeks when vasomotor stability is lost in the skin (4) that bed sores are most likely to develop.

Except for the ever-present specter of bed sores, the patient is usually a cursing problem of ordinary degree during the period of depressed reflex activity taking into account

the special attentions to the bladder the skin and the state of nutrition. Neurological recovery if it is to occur will show some signs fairly early and the persistence of depressed reflex activity with or without any plantar responses, usually means that a complete physiological if not anatomical lesion exists. Sherrington discussed the period of shock in a few paragraphs, hardly improved upon to this date when he stated, "Spinal shock appears to take effect in the aboral direction only. Section behind the brachial enlargement disturbs little if at all the reactions of the fore limb although the number of headward running channels of conduction ruptured by such a section is enormous. On the aboral side of the transection depression is profound. The view of Golts and his school that spinal shock is a long lasting inhibition due to irritation by trauma is not, I think, really tenable. Were the mere irritative actions of the trauma the cause it is not easy to see why the nervous centers near the trauma should not be depressed on either side of for instance a spinal transection headward as well as backward. The practical absence of spinal shock on repetition of the trauma further back is explicable by its then causing little further aggravation of the interruption of the nervous channels concerned with vascular tone and vascular reflexes those channels having already been ruptured by the previous transection somewhat further headward. There remains the further question as to whether spinal shock is a phenomenon of inhibition. The condition of the spinal reflex-arc in spinal shock appears to resemble a general fatigue rather than an inhibition. It renders difficult and uncertain the process of conduction along the reflex-arc as judged by the discharge from the terminal neurone. This suggests a loosening of nexus between the links of the neurone chain composing the arc a defect of transmission at the synapse. I think therefore, that spinal shock is either due to irritation by trauma or to the main a phenomenon of inhibition. The rupture of certain aborally conducting paths appears to induce it. The deeper depression of reaction into which the higher animal as contrasted with the lower

sinks when made 'spinal' appears to me significant of this that in the higher types, more than in the lower, the great cerebral senses actuate the motor organs and impel the motions of the individual

The early phase of reflex depression has been studied in four groups of cats in which injury of the spinal cord was produced. Eight cats were operated upon and severe pressure exerted upon the 4th thoracic segment of the cord for 3 6 12 18 24 48 72 and 96 hours following which the animals were killed. A second group was similarly operated upon except that at the end of these periods of pressure the animals were again operated upon and the mechanism of pressure removed. In a third group 2 cats were subjected to electrocoagulation of all the blood supply of the isolated 4th thoracic segment and in a fourth group 4 other animals were subjected to total maceration and complete destruction of the cord at that level. Certain of the animals in the second series regained some function but in the animals of all groups the so called shock was equally early and severe. As has already been pointed out, the genital reflexes and the occasional flexion of the toes on plantar stimulation, particularly with noxious stimuli occurred in patients as early and as actively regardless of whether or not the cord was completely transected or severely crushed or whether any other form of trauma was the cause of interruption of normal physiological function. Furthermore, the profoundness of the absence of other forms of reflex activity will be found to be the same when there is complete physiological (with or without complete anatomical) interruption of the cord. The problem which remains unanswered therefore is the cause of this sudden and persistent state of depressed reflex activity increasingly profound as one ascends the phylogenetic scale.

Riddoch apparently also accepted the theory that separation of the effector mechanism from cerebral control was the cause of the altered post traumatic reflexes. It seems to us, however, that if the conditions of altered reflex activity were due solely to loss of cerebral direction because of neuronal interruption, the state of change should remain the

same from the time of injury since the interruption once effected is final. It would seem more logical that at least one factor in the appearance of these reflex states would be a change in the intact and adequately vascularized segment of cord and its peripheral nerve and end organs below the level of the lesion of a histological and chemical nature. If that were true it is possible that, during the state of depressed reflex activity the various parts of the reflex arc including the myoneuronal junctions are inactive in a period of reorientation and reorganization of function for a state of autonomous function of a primitive nature. In this state of autonomy however the organs most affected, the muscles do not atrophy apparently because of the viable cord even though connection with the upper motor neuron is lost.

THE STATE OF HEIGHTENED REFLEX ACTIVITY

In our group of 490 patients with spinal cord injury 16.3 per cent were of the cervical cord, 59.6 per cent were of the thoracic cord, and 24.1 per cent were of the conus and cauda equina. Obviously lesions of the cauda equina are not to be discussed with those of the spinal cord when spasm is considered. Sixty-four per cent of the patients suffered injuries of the open type, as bullet, shrapnel or stab wounds of the cord. Thirty-six per cent were patients with closed injuries such as occur in a fracture-dislocation of the spine. A certain number of both types have led to surgical exposure of the lesion either early or late and while we have seen active complete gross anatomical separation of the cord such a state of affairs is the exception rather than the rule even in the severest of either type of injury. The question is always present as to whether the lesion is complete or 'partial'. It seems reasonable to believe that a few remaining shreds of cord tissue are incapable in most instances of remaining viable and of transmitting impulses since such isolated tissue must necessarily suffer secondary softening and degeneration due to pressure or ischemia. We have seen many cords at the level of a fracture-dislocation which appeared slightly contused and swollen while others have been

found in a severe state of crush or even shredded and avulsed but as Naffziger has pointed out if neurological signs do not indicate at the end of 24 hours some viability of the cord or parts of it at the level of the lesion especially by the signs of beginning recovery then most likely no neurological recovery will ever occur. It should be stated here however that since that very question of viability cannot early be determined every opportunity should be afforded to insure the preservation of any such viability by the surgical removal of all causes of local pressure.

It is unfortunate that in neither animals nor man can the complete anatomical and complete physiological lesion be differentiated early. By far the greater number of patients with early complete loss of all neurological function but without gross anatomical section of the cord remain as profoundly and persistently lacking in return of function as do those known to have had the cord actually severed. We have seen little difference in the deep tendon reflexes, plantar responses, muscle spasms genital and viscerovisceral reactions in patients with clean anatomical cord section and those with crush, preservation of continuity of the cord but permanent failure of neurological recovery. Gross anatomical section assures the physiologically complete lesion but a severely contused cord undergoes such softening with later gliosis that it too is in a microscopic sense anatomically severed.

Be the injury cervical or thoracic, open or closed with a complete lesion of the cord as indicated either by surgical verification or by the long persistent failure of recovery the severity of the heightened reflexes varies from patient to patient. There are those patients who never at any time develop anything more than the mildest degree of spasm while others early and rapidly progress to such a condition of hyperactive reflexes that the persistent deformity calls for specific medical or surgical care. It has been our observation that the early care of the patient has much to do with his later period of heightened reflex activity. When the proper surgical care has been given early and when all supportive measures such as early ambulation of the patient, physical therapy proper care of the bladder the avoid-

ance of decubiti and the other sources of sepsis and general debilitation have been attained our patients have been spared later excessive reflex activity and all the attendant ills. The single greatest factor that is under control of those who care for such patients in securing a smooth convalescent course is the avoidance of sepsis especially that which arises from the urinary bladder. Spasm has been greatest in those patients injured in a theater of war where their early care was of ten incomplete and where early a state of sepsis and malnutrition was established. Invariably patients ideally cared for in civilian life have not been found to develop such severe and disabling reflex activity. The incomplete lesion as would be expected produces less severe spasm according to the degree of neurological loss.

The date of onset of the phase of heightened reflex activity is not affected by the severity of the lesion its completeness, or whether it is in a patient with a closed or open wound of the cord. We have seen many patients with incomplete lesions whether verified surgically or by the results of neurological examination and continued observation who developed increased reflex activity as soon as those with complete lesions. In many patients with incomplete lesions recovery will manifest itself within a few hours or days, however and with the appearance of neurological recovery the state of shock must be said to have terminated. Few incomplete lesions show bilaterally symmetrical loss and therefore the resultant state of hyperactive reflexes is seldom the same in the lower extremities. The patient with a completely severed or a hopelessly crushed cord will usually develop the state of heightened reflex activity no sooner or later than the patient with the contused cord which never later shows any neurological function. The date of the surgical treatment if given, regardless of its type, has not been found to affect the date of onset of the heightened reflexes. Patients have been seen who never exhibited any so called spinal shock for more than a few hours with essentially an immediate onset of hyperactive bizarre reflexes (examples one patient with a complete lesion at seventh cervical and another with an incom-

den influx of blood rather than actually erect in the usual sense. We have never observed the emission of semen and upon extensive questioning of the patients we found that it is the exceptional patient who has seen that phenomenon. Occasionally semen like material in small quantity may be seen at the meatus around the catheter or the patient may report that he has seen a quantity of white ropey material in the freshly passed urine. Those few patients admitting masturbation report the failure of any seminal emission. Nocuous stimuli to the erect penis produces a prompt return of the organ to the flaccid state.

It is commonly stated that perspiration does not occur below the level of a complete lesion yet we have many times seen such profuse dripping perspiration over the buttocks and thighs with lesions as high as the fourth thoracic as to be a threat to the development of macerated skin and of decubiti. These same facts were described in detail by Head and Riddoch. We have further observed especially in the upper thoracic lesions that a full bladder just before its automatic evacuation or a bowel distended by an enema, may produce an extensive flush of the body above the lesion headache perhaps nausea, goose-flesh on the skin of the lower extremities and finally on evacuation a return to a normal color of the skin of the face neck and arms with the sudden appearance of beads of sweat over the thighs and trunk (Davis and Martin 1933). Rarely with a lesion at any level have we found the ankles or feet to show more than a minimal amount of perspiration. In many patients these same visceral responses may follow strong stimuli that produce flexor activity such as pricking of the soles of the feet. We have found that after the first 8 or 10 days during which the bowels are usually constipated manipulations of the lower extremities bathing the patient, or changing his position may result in the sudden evacuation of the bowels. As the months wear on however the bowels develop a tendency to either spontaneous evacuation or evacuation after enemas or digital stimulation of the rectum but in any case with a decreasing tendency to take part in the generally heightened reflexes. The

visceral reflexes tire easily more readily than those of the striated muscles, but they are equally sensitive in the resting patient. Given a patient who has been lying quietly in bed without even the stimulation of covers touching his exposed skin the slightest touch on the thigh or groin may cause a spurt of urine, whereas a series of such minimal stimuli are usually necessary to evoke a notable response of the muscles of the lower extremities.

Of the present group of 490 patients, 372 were patients with cord injuries, and 118 with injuries of the cauda equina. Of the 372 80 patients had injuries of the cervical cord, and 292 were patients with thoracic cord injuries. Every one of these 372 patients had during some period of his record some degree of spasm in the lower extremities following the first few days or weeks of decreased reflex activity. By no means was the spasm of such degree as to cause the patient concern or require treatment in all the patients.

In the vast majority of these patients adequate nursing care well directed physical therapy and the maintenance of the general physical well being of the patient (especially by the avoidance of a septic bladder and bed sores) have kept the patients comfortable and allowed them to be sufficiently mobile to permit some mechanical aid to ambulation be it a wheel chair crutches, or braces. The nutritional care of the patient must not be lost sight of in the strenuous program of physical therapy.

The treatment of these patients whose condition demanded relief of the spasm has been either medical or surgical or in some instances, both. In general the use of the common sedatives, as bromides, has not affected the hyperactive reflexes. Curare in its various forms has been used on a considerable number of patients but as yet a prolonged effect and the avoidance of undesirable side effects have not been attained. Posterior rhizotomy as well as the intrathecal injection of alcohol have been used in isolated instances without effect before the patients came under present study. In those patients having been treated by posterior rhizotomy no untoward effects on the skin of the affected segments have been noticed. Anterior rhizotomy as high as the tenth

thoracic inclusive performed in 17 patients has been uniformly successful when applied over a sufficiently great enough number of segments but the operation has been studiously avoided until it was established beyond doubt that the lesion was complete. It has not always been easy to isolate the anterior from the posterior roots at time of operation nor has it always been a simple matter accurately to identify the segments. This is especially true when the injury is at the spinal levels of the eleventh and twelfth thoracic and first lumbar. In 2 patients the scarred proximal and distal ends of the severed cord have been freshly resected with the local removal of all irritating factors, such as abnormal vascular ingrowths, bone fragments, ligamentous cicatrix, and callus, but without prolonged or noticeable effect. Some patients suffering predominantly from adductor spasm and in whom the tendency for the lower extremities to cross has been a real impediment to their otherwise possible ambulation have had immediate relief with an improvement in their use of canes, crutches or braces following the bilateral section of the obturator nerve as approached through the lateral reaches of the space of Retzius. Walking is not interfered with by this procedure which has been performed in 22 patients. There is a smaller group of patients who after months of deformity by severe flexor adductor spasm are not relieved by anterior or posterior rhizotomy because of tendon contractures. These patients are treated by tenotomy at the involved joints.

One may safely assume that Sherrington, Riddoch and even earlier observers believed that the heightened reflex activities of the cord are due to the release of the isolated segment from cortical control and in a sense to the reduction of that isolated segment with the various components of its reflex arcs to a lower phylogenetic status. All these earlier authors are less committal as to the cause of the first stage that of depressed reflex activity. Scarff and Pool have recently shown why they believe that the spasm may be due to local irritation from cicatrix at the level of the lesion. It is certain that a viable cord segment must exist for the full exercise of the reflex arcs

however 'abnormal' the reflexes may appear. But as has been pointed out reflexes of the same severity, persistence and bizarre pattern have been seen in those patients with cords crushed with loss of function and maintenance of gross anatomical continuity as in those with proved complete transection. Furthermore it has not been found that clean surgical resection of the scarred stumps has a favorable effect for more than a few hours or days if at all.

Studies of the isolated cord segments made by us in experimental animals have revealed nothing more significant than the expected degeneration of the descending pathways. What is lacking is our knowledge of the histological alterations in the motor end plates, internuncial neurones, and the sensory nerve endings at the various stages from the time of injury to the time of full development of the hyperactive reflex state. We lack too the knowledge of what certainly must be biochemical changes in these structures especially at the myoneural junction. If it were *only* a matter of release from cerebral control we would not have the good evidence of progressive histological and chemical change in the reflex arc as evidenced by the changes in the reflex state over a period of months.

Riddoch's meticulous and detailed description of his patients indicated his feeling that there is a *constancy* of reactions in both the complete and incomplete lesions. Quite on the contrary this study has emphasized the great variability of the type, date of onset, severity and the characteristics of the altered reflex states from one patient to another. It has not been possible to rely upon any one of the characteristics of the reflexes for purposes of diagnosis or prognosis except to feel that the flexor adductor reaction is characteristic of the complete lesion whereas the extensor response is more often seen in the incomplete lesion, there being frequent exceptions to this loose rule in both instances.

The very facts that certain patients develop extremely little spasm, that some develop it very early and others very late that some show extensor and other flexor responses with the same type of lesion, that the viscerovisceral reflexes are very marked in some pa-

tients and that in some patients the spasm may spontaneously become greatly abated as well as the fact that in the majority of patients sepsis definitely increases the severity of spasm indicate that the adaptability of the isolated cord and its attached peripheral mechanisms to its new independence varies in patient to patient and that this adaptability as indicated in the variety of responses is a matter of intrinsic change anatomical or chemical or both within the various parts of the arc. It is toward a knowledge of these changes that our attentions should be directed rather than solely to the observation and

recording of the dramatic neurological changes demonstrated by physical examination.

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ATYPICAL ADYNAMIC ILEUS APPARENTLY CAUSED BY NUTRITIONAL (THIAMINE CHLORIDE) DEFICIENCY

Report of Six Cases

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DURING the past 5 years, I have observed 4 instances of severe abdominal distention in which the clinical history physical findings and response to therapy strongly suggest that the adynamic ileus was caused by serious nutritional deficiency. These cases brought to mind 2 additional cases observed earlier with similar clinical courses which had not been satisfactorily explained at the time of observation. Review of these 2 case records indicated that they belonged in the same group which may represent a distinct clinical entity of special interest to surgeons since the abdominal distention is so pronounced that acute intestinal obstruction is suspected.

Four patients were chronic alcoholics. In 3 instances celiotomy was performed because of the severe abdominal distention in 2 the condition was erroneously diagnosed as acute appendicitis and in 1—on the basis of obstructive symptoms and the roentgenologist's report—the diagnosis was annular carcinoma of the descending colon. In 1 pronounced distention developed on the fourth day after an operation for inguinal hernia. In the last 2 cases no operation was performed, since the cause of the severe abdominal distention was recognized as nutritional deficiency. Neither of these patients was an alcoholic but the histories revealed that both of them had been on greatly restricted therapeutic diets one for biliary disease, and the other for weight reduction.

CASE 1: A man aged 41 was admitted to Deaconess Evangelical Hospital on March 19, 1942. He was suffering with abdominal distress and distention, diarrhea, pyorrhea, loss of appetite and pains in the calves of his legs. He had had treatment for the diarrhea and pyorrhea for 3 weeks prior to admission without relief and had lost 13 pounds in weight. Careful questioning revealed that the

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diarrhea consisted of approximately 10 to 15 very small soft stools daily.

Physical examination showed that the patient was emaciated with a waxy pallor, there was a pronounced gingivitis, and considerable abdominal distention. The remainder of the physical examination, including a sigmoidoscopic examination, yielded normal findings. Several examinations of the feces showed no ameba, mucus or blood. The X ray diagnosis was annular carcinoma of the sigmoid.

This diagnosis was questioned since there was no occult blood in the stool. Attempts at decompression with the Wangenstein suction apparatus were made but after 3 days the abdominal distention was not relieved. An exploratory celiotomy revealed pronounced dilatation and engorgement of the descending colon from the splenic flexure to the anus. The colon was thickened and edematous, and the veins were dilated. There was no evidence of tumor constriction or obstruction in any part of the left colon. The cause of this condition could not be determined at the time of operation.

The day after operation extensive palpable rales were present in both lung fields. The mucus was eliminated periodically by coughing in the standing position. The distention which was present before the operation became more pronounced and could not be controlled. By the fifth postoperative day the pyorrhea which had been present previously developed into a severe generalized stomatitis. The patient also developed hallucinations. At that time a more careful inquiry into his past history by questioning a member of the family brought to light the fact that he had been a pronounced alcoholic before the onset of the present illness, although excessive use of alcohol had not been admitted when the routine history was taken. This suggested a vitamin B deficiency as a possible cause of the distention and stomatitis and vitamin B complex was administered orally and parenterally. (However the recommended dosage used at that time is not now considered adequate). During this same period prostigmine was administered intramuscularly several times daily. The response from this drug is immediate, but it produced no appreciable effect on the distention or on intestinal motility. Table I shows the record of the bowel evacuations before and after operation and after the administration of vitamins and prostigmine. The delayed response suggests that it was the vitamin B complex and not the prostigmine that benefited the patient.

TABLE I—RECORD OF BOWEL EVACUATIONS BEFORE AND AFTER OPERATION (CASE 1)

Date	Bowel evacuations	Remarks
3-30	7	
3-31	4	
3-	4	
3-32	5	
3-34	6	
3-35	4	
3-36	3	
-37	3	Operation performed
-38		Patient ambulatory
3-39	3	
3-40		Nutritional deficiency recognized
3-5		5 mgm. thiamine chloride administered
4-		B complex administered for 10 days
-		
4-		
-	8	Patient confined to bed
- 5	5	
4- 6	4	Wangsten's suction discontinued
7	3	Melarsol, capsule i d proutigmine, supel 4 i B complex increased to 10 mgm. daily
4- 8		
-		
-		
-		Proctoguard, suppel b d
4-10		
4-		
-14		
- 5		
- 6		
4-11		
4- 8		
4-11		
4-10		
-14		
4-		
4-11		

This patient's history of distention and diarrhea, with loss of strength and weight, supported a medical diagnosis of cancer which was confirmed by roentgenographic findings interpreted as indicating annular carcinoma of the sigmoid flexure. Since this was the

first case of this type encountered, there was no suspicion that the distention might be related to a nutritional deficiency especially since excessive use of alcohol had been denied. The fact that before the onset of gastrointestinal symptoms the patient had been drinking heavily was not learned until 5 days after the operation.

CASE 2 An Italian, aged 41 on September 21, 1942 was sent to the hospital by his physician because of generalized abdominal distress, which had appeared about 24 hours previously. Examination revealed that the abdomen was grossly distended and tense. The tension was so great that it was impossible to determine the degree of muscular rigidity if any. The blood count showed 9,700 leucocytes, the differential count was 90 per cent polymorphonuclears, 8 per cent lymphocytes, and 2 per cent monocytes.

A provisional diagnosis of ruptured appendix was made, and an exploratory celiotomy was performed. The small bowel was tremendously distended, edematous, and congested, there was no fluid in the peritoneal cavity and the appendix was not readily accessible without producing undue trauma. Therefore an adequate exploration could not be made. The abdomen was closed with a small soft rubber drain in the right pelvis.

After operation the abdominal distention became more intense, despite continuous use of a Wangsten suction apparatus. The patient became irrational with muttering delirium periodically, and had to be restrained. There was no evidence of infection, since the temperature did not rise above 100 degrees F. there was no drainage from the wound and a small soft stool was evacuated. No attempt was made to institute ambulation because of the tremendous abdominal distention and serious morbidity of the patient. However in-bed exercises (contraction of voluntary muscles) were carried out systematically between periods of delirium.

In view of the similarity of the clinical picture to that which had been observed previously in Case 1 a more thorough investigation was made on the second postoperative day in regard to the patient's consumption of alcohol. Although, when the history had been taken originally he had stated that he drank only moderately specific inquiry as to the amount consumed indicated that he had been disposing of several quarts of red wine a week, a case of beer each week-end and some whiskey daily for a period of several years. These data furnished a basis for suspecting a nutritional deficiency and thiamine chloride (30 mgm.) 1 ampole of vitamin B complex, and 100 milligrams of ascorbic acid were administered parenterally along with proctigmine.

Some improvement was evident the following day. The patient passed some flatus, but the distention did not decrease materially until 48 hours after the administration of the thiamine chloride, other vita-

mins and prostigmine. He then became ambulatory and improvement was rapid. (Since as in Case 1 the response was gradual rather than immediate it seems probable that relief of the distention cannot be attributed to the prostigmine which at first was administered every 2 hours for 2 doses and there after in a dosage of 1 ampule daily.) By the fourth postoperative day, the distention was almost completely relieved, the patient became rational and his general improvement was striking. There was no discharge from the wound and the drain was removed. He was discharged, ambulatory on the eighth postoperative day and his general condition continued to improve.

This case recalled the experience described in Case 1. The presence of uncontrollable distention in this instance led to the suspicion of a nutritional deficiency, and this was substantiated by eliciting a definite history of alcoholism. Since the appendix was not removed and there were no discharge through the drain and no later evidence of a localized abscess and since the patient recovered completely and has remained well it would seem probable that the nutritional deficiency accounted for both the preoperative and postoperative distention.

CASE 3 An Italian aged 64, with a typical beer belly type of obesity, drank approximately 1 case of beer every week and about 2 glasses of wine daily. He had been well until 3 weeks before admission when he developed a left inguinal hernia.

The patient was advised to discontinue taking alcohol for 1 week, and then a herniorrhaphy was performed. He was ambulatory after operation. Pronounced abdominal distress and distention developed on the second postoperative day and Wangersten suction was instituted. This afforded some relief but the distention could not be adequately controlled. The patient was out of bed at frequent intervals for coughing, and expectorated some mucus on these occasions for several days. Decompression was discontinued on the sixth postoperative day and the patient began to take some nourishment. He improved gradually and was dismissed on the twelfth day after operation.

Although this patient was observed in January, 1942 before the experience with Cases 1 and 2 and hence vitamin deficiency was not suspected it seems probable that the severe postoperative distention in this instance was due to a nutritional deficiency secondary to chronic alcoholism. With ambulatory treatment and other supportive measures the condition was brought under control. Several months later vitamin B complex was

prescribed for this patient with considerable improvement in his general health.

CASE 4 A man aged 52 was admitted to the hospital on January 7, 1938 with a diagnosis of acute appendicitis. He had been well until 4 days previously when he developed abdominal discomfort and distention, with tenderness over the right lower quadrant. The patient took a laxative, which initiated a diarrhea. On previous occasions he had also had frequent small soft stools. He finally consulted a physician who advised hospitalization and operation. On examination the abdomen was considerably distended and tympanitic there were no masses or scars but there was tenderness over the right lower quadrant.

Appendectomy was performed by my associate. The appendix was retrocolic, bound down with very dense adhesions and was removed with considerable difficulty because of the distention. A small soft rubber drain was inserted. Pathologic examination of the appendix showed catarrhal changes, edema and congestion, evidently not the cause of the patient's complaint.

After operation abdominal distention became pronounced, and Wangersten suction was instituted. The patient was irritable, restless and complained of abdominal distress. Parenteral fluids were administered as indicated. However he became increasingly restless, irrational and eventually violently delirious (typical alcoholic delirium). Abdominal distention could not be controlled at any time by decompression.

After the appearance of the typical delirium tremens members of the family admitted that the patient had been a chronic alcoholic for years. Since this patient was treated before early ambulation was routinely used in the management of surgical cases, he was placed in shackles to keep him in bed (Out-of-bed exercises, however, probably would have been helpful.) His clinical course was steadily downward with progression of abdominal distention to paralytic ileus, increasing delirium and finally death.

At autopsy, there was gross abdominal distention, but careful dissection of the operative field showed that the operation was ideal from the standpoint of surgical and gross anatomical pathology. The pathologist's diagnosis was adynamic paralytic ileus, early portal cirrhosis of the liver, terminal hypostatic pneumonia.

This case was observed several years before Cases 1 and 2 and before early ambulation was used routinely. It was not suspected at that time that a nutritional deficiency played any part in causing the adynamic ileus. After the experience with the other patients, however, this case was recalled and reviewed and it would appear in retrospect that this patient belongs in the same group. The diarrhea and

distention before operation the anomalous findings in the appendix the uncontrollable distention and delirium after operation the history of alcoholism and postmortem evidence of liver damage all point to this conclusion. If this entity had been recognized at that time in all probability no surgery would have been performed in case operation had been performed if present methods of management had been used—that is early ambulation and administration of thiamine chloride—it seems probable that the fatal outcome might have been averted.

CASE 5 A woman aged 33 was admitted to the hospital on November 3, 1943. For about a year before she had been having attacks of epigastric abdominal pain which occurred at irregular intervals and had been relieved by codeine. Before the onset of these attacks, her diet had been varied and well balanced. Five months before admission, her physician made a diagnosis of biliary colic and advised her to go on a diet excluding meat, almost all vegetables, all highly seasoned food, butter, gravy, fats and coffee. Her diet was limited chiefly to toast, tea, milk and ice cream. The only other foods she ate were carrots, pie, cake, cookies, apples and pears. After about 5 months on this regimen she had an attack of abdominal distress and ate very little during the following week. During this period abdominal distention developed, and the patient was hospitalized. Wangensten suction with the Levine tube was instituted and she received glucose in normal saline solution parenterally. For the following 15 days, she was unable to take food. Despite the Wangensten suction and use of enemas, the abdominal distention increased; this was associated with much discomfort, but no pain. She passed small soft stools nearly every time she urinated (about four or five times a day).

The roentgenologic findings were atypical, and the roentgenologist's opinion was somewhat indefinite and inconclusive. On November 12, 10 days after admission the report was as follows: "The examination of the stomach reveals a mottling or nodulation of the barium within the stomach as a result of a large amount of fluid. The same condition is found in the small intestines. The barium passed through the esophagus without visualizing any abnormality. The stomach was fish-hook in formation and hypotonic in fact, atonic. A large amount of fluid is within the stomach and the patient has tenderness above and medial in the epigastrium. The duodenal bulb showed a normal contour. There was practically complete retention at 5 hours. The barium enema passed through the whole length of the colon without visualizing any evidence suggestive of obstruction or neoplasm. A large amount of barium passed through the ileocecal valve and

we note that there is also some barium within the stomach at 24 hours. Conclusions: The patient apparently has a gastric ulcer close to the pylorus with evidence of gastritis. A supplementary report will follow later."

Following is the verbatim report of the supplementary study on November 15:

"The review of the films and further study of the gastrointestinal tract would suggest the following: On the films we note a crater close to the pyloric end of the stomach which we believe is due to a duodenal ulcer. But we are not able from the films, to account for the retention of the stomach at 5 hours and 24 hours, and would suspect that there would be an obstruction at the pylorus or duodenum. But we fail to find a definite obstruction. We also note that the small intestines are distended in fact, over distended suggesting the possibility of obstruction in the terminal ileum. But it was impossible to get a very good visualization of the small intestines. On the large intestines we note that there is no distention and that the descending colon is rather spastic. There is also irritability of the transverse colon. Summing up the case, one would be suspicious that there may be an obstruction at the terminal ileum or that this may be a metabolic disturbance similar to a dietary deficiency. Still I am not able to get away from a possible organic lesion in the terminal ileum."

Two days after this second roentgenologic report (November 17) I was called in consultation to consider the advisability of surgical intervention since the physician assumed that the condition was due to intestinal obstruction even though the roentgenologist had mentioned the possibility of a nutritional deficiency. After a more careful and complete history was obtained which along with the pronounced intestinal distention, distress but no pain, and several small soft stools daily, presented a picture similar to that of Case 1, a diagnosis of vitamin deficiency was made. At that time, the serum albumin was 3.2 and the serum globulin 4.6.

Treatment for the nutritional deficiency was instituted immediately. This consisted of thiamine chloride 100 milligrams intravenously, 1 ampule of solu B, intramuscularly, and amino acids, intravenously. A siphon suction unit (12) with the Cantor tube (3) was introduced for intestinal decompression. This was removed 2 days later when another roentgenologic study revealed no evidence of any mucous distention anywhere in the gastrointestinal tract, either in the flat or upright films.

Five days after treatment was instituted, the patient's condition was greatly improved; distention had disappeared, there was no vomiting, she tolerated food well and was ambulatory. The serum albumin was 3.6 and the serum globulin 2.9. The patient left the hospital 10 days after vitamin therapy was started (November 28) completely well. She received detailed instruction regarding a high-vitamin, high-protein diet. She has followed this and has had no recurrence of symptoms.

In this instance although the patient was referred for surgical treatment for a supposed intestinal obstruction, the cause of the symptoms was recognized as nutritional deficiency which had produced an adynamic ileus and no operation was performed. The patient's response to thiamine chloride and protein therapy was striking, and with correction of her diet, she has remained completely well.

CASE 6. A man aged 53 consulted his physician for an annual health examination. He had complained of no illness but was overweight. After a complete examination including an electrocardiogram and roentgenologic study of the gastrointestinal tract and gall bladder and a sigmoidoscopic examination, all of which yielded normal findings, his physician recommended a restricted diet for weight reduction. The patient followed this diet for several weeks, but was not satisfied with the rate of weight loss and so restricted his diet to the following: breakfast—1 slice toast, orange or grapefruit; black coffee; luncheon—meat, fresh fruit; dinner—meat, vegetables including only lettuce, spinach, carrots, and peas and canned fruit.

On this diet which was extremely deficient in variety, he lost approximately 20 pounds in 2 months. During this period he tired easily and felt exhausted most of the time. He felt that he was not so keen mentally, was irritable and suffered from pains in the calves of the legs. His abdomen became bloated and distended and bowel evacuations occurred two or three times a day but these did not relieve the distention. Finally the distention increased enormously and respiration was embarrassed at this point the patient became alarmed and consulted me. Except for the tremendous abdominal distention, physical examination revealed nothing abnormal. Although the patient complained of considerable distress there was no belching, passing of flatus or actual pain. Since a health examination including a complete gastrointestinal and gall-bladder roentgenologic study and a sigmoidoscopic examination had recently been made it was concluded that this patient was suffering from an acute adynamic ileus on a nutritional basis (thiamine deficiency). Thiamine chloride 100 milligrams was administered and repeated in 4 hours; this regimen produced complete relief in 12 hours. The injections were continued daily for several days and the nervous symptoms, leg pains and irritability disappeared completely. Bowel evacuations decreased to one a day. The patient received dietary instruction and therapeutic doses of vitamin B complex orally. His general health has remained excellent, with no recurrence of gastrointestinal symptoms. The patient says that he feels by far more alert and has never been more fit in his life.

In this instance as in Case 5 the cause of the severe abdominal distention was recog-

nized after a dietary history was obtained. Response to administration of thiamine chloride was prompt and spectacular.

DISCUSSION

Despite the enormous number of clinical and experimental studies on nutritional deficiencies that have been reported during the last few decades and the increasing precision of knowledge concerning them it would appear that numerous clinical problems associated with these disorders remain to be elucidated. So far as could be ascertained by a search of the *Quarterly Cumulative Index Medicus* for the past several years the exact clinical syndrome here described has not been previously reported even though the recognition of digestive symptoms as a phase of vitamin B deficiency has been well established clinically and roentgenologically (5, 9, 19). In previous reports however there has been no emphasis on the fact that severe and uncontrollable abdominal distention¹ which might lead to erroneous surgical diagnoses and needless operations may be the result of vitamin B deficiency.

The roentgenologic studies made by Golden (5, 6, 13) have stimulated interest in the relationship of vitamin deficiency to intestinal motility (1, 2, 7, 8, 10, 15, 18) and the so called deficiency pattern of the small intestine is a fairly well defined radiologic entity. However, as Golden (5) has emphasized the roentgenologic findings are not constant and appear to vary with the severity and duration of the nutritional disorder. In earlier less advanced stages the barium passes rapidly through the jejunum reaching the lower part of the small intestine in 15 minutes and entering the cecum in less than half an hour; the lumen is reduced to one-half or even one-fourth its normal width. In more advanced stages movement of barium through the intestine is slow and

In retrospect, it is my impression and that of numerous surgeons with whom I have discussed the problem, that immediately after the first World War abdominal distention and adynamic ileus were much more common and troublesome complications in surgical cases than they have been in recent years. In fact, it was to meet this problem that the Wangensteen suction apparatus for decompression of the intestinal tract was developed. Although undoubtedly some of the decreased incidence of adynamic ileus can be attributed to more general use of mechanical decompression and improved surgical technique, it is possible also that it is due in part to improved nutrition and the widespread use of supplementary vitamins by the general public.

the lumen may vary from normal to more than twice normal width. Dilated loops are characteristically seen in well advanced stages which are usually designated clinically as non-tropical sprue. There is abnormal segmentation owing to areas of spasm of variable length sometimes completely expelling the opaque material from the contracted area giving the impression of a discrete mass. A scattering effect may be caused by small irregular masses of barium left behind as the main mass of barium passes along. In more advanced stages, gas and fluid levels on plain abdominal roentgenograms may suggest the possibility of ileus. The most marked and persistent changes are localized in the middle third of the small bowel.

Not all patients with clinically diagnosed vitamin B deficiency show the roentgenologic changes in the intestine and conversely the typical roentgenologic changes have been observed in patients in whom vitamin B deficiency was not confirmed clinically (15). Disturbances of the digestive tract associated with vitamin B deficiency cause a variety of symptoms, so the clinical picture is not constant. The main features of the syndrome described by Lepore and Golden are malnutrition, a flat oral dextrose tolerance curve, an abnormal roentgenologic pattern in the small intestine and gastrointestinal symptoms including flatulence, pain, diarrhea (in 25 per cent) and constipation. (In this series malnutrition was a prominent feature only in Case 1.) Brown and Trowell have reported a syndrome they have seen in Polish refugees and in African and Indian adults and children in which the roentgenologic picture is similar to that described by Golden and the symptoms suggestive of pyloric obstruction. In their cases great gaseous distention of the colon was common. This syndrome responds to administration of whole vitamin B complex. Heilig has reported that a high percentage of hospital beds in Mysore, India, are occupied by patients, mostly young or middle-aged women with chronic diarrhea of a few weeks to 2 years duration. After the exclusion of true dysenteries, a certain group have glossitis, loose stools 5 to 8 times daily containing substantial amounts of mucus and

starch granules but no fat. In cases of long standing symptoms of colitis become prominent. Hypochromic anemia belongs with this condition, increasing with duration. None of the patients showed typical signs of pellagra and none had fatty stools of sprue-like character. Nevertheless many responded surprisingly quickly to nicotinic acid although refractory to routine treatment.

These few reports are cited to show that the digestive symptoms accompanying vitamin B deficiencies are not constant, and may manifest themselves in various syndromes. Numerous extrinsic and intrinsic factors apparently account for this variability which is dependent both on the lack of particular food factors, individually or in combination, and the duration of the deficiency and on individual metabolic differences in ability to utilize them which in turn are influenced by various acute and chronic diseases. As Kiefer has stated, vitamin deficiencies particularly those involving the vitamin B complex group of vitamins can profoundly impair digestion and absorption of essential food elements, including carbohydrate, protein and fat. Since malabsorption further diminishes the subject's vitamin intake, a vicious circle is established." In sprue and related conditions—such as Herter's infantism, Gee's disease and idiopathic steatorrhea—the basic disturbances apparently are related to fat metabolism. In the syndrome described by Heilig the basic disturbance apparently was related to utilization of carbohydrate. In at least one of the cases reported here (Case 5) there was evidence of a disturbance in protein metabolism. These facts indicate that the metabolism of any or all of the essential food materials may be impaired by vitamin B deficiency since all these conditions respond to administration of vitamin B complex or one of its components.

As Golden (5, 6) has pointed out, the intramural nervous system is the most probable medium through which nutritional deficiency affects the intestinal tract. Essentially the same type of radiologic pattern of the intestines as that found in well advanced deficiency states is present in normal newborn infants, which, after 3 or 4 months is replaced

by the usual adult pattern. This change is probably due to evolution of the incompletely developed nervous control of the intestine.

Experimentally, it has been demonstrated (17) that cholinergic nerves liberate not only acetyl choline but also thiamine, when stimulated and that thiamine increases the effect of acetyl choline on the intestine and circulatory apparatus of the cat. Chemically acetyl choline and thiamine chloride are closely related compounds and hence may function synergistically. It seems probable that these facts furnish clues as to the mechanism of production of adynamic ileus in the presence of thiamine deficiency and as to the striking therapeutic response to administration of thiamine chloride parenterally.

In the cases in this series the characteristic pathologic changes encountered were edema and thickening of the intestinal walls with engorgement of the blood vessels. In fatal cases of deficiency disease in which roentgenologic changes have previously been demonstrated in the intestine atrophy of the tunica muscularis and mucosa, edema, round cell infiltration and fibrosis of the submucosa and ulceration have been described (5).

The type of pathologic changes in the intestine and the variety of gastrointestinal symptoms that have been described in deficiency states suggest that it would be wise to suspect a nutritional disturbance in any case in which the digestive symptoms, clinical and radiologic findings seem atypical or anomalous. It might be in this way that the etiology of certain obscure gastrointestinal conditions might be elucidated. It may even be justifiable to raise the question whether nutritional deficiency may play a rôle in the causation of at least some cases of so called nonspecific regional enteritis especially in view of Owen's (14) recent pathologic study, which showed neuromuscular hyperplasia as a characteristic feature of this condition, not previously reported by others.

Owing to the unscientific and unscrupulous propaganda and advertising concerning vitamins by certain drug manufacturers, many medical men have taken an extremely cautious attitude toward the use of vitamins, and hesitate to designate any condition as caused by

nutritional deficiency unless the characteristic lesions of well advanced stages of the deficiency are present. This attitude seems scarcely justifiable in the present state of our knowledge concerning these conditions because of the variability of the manifestations in so called *subclinical deficiency states* and the constant descriptions of 'atypical syndromes' responding to vitamin and nutritional therapy.

In the absence of the so called characteristic lesions the response to therapy must be accepted as significant evidence that a nutritional disturbance is the cause of particular symptoms. Of the patients here described whose symptoms of adynamic ileus were dramatically relieved by administration of thiamine chloride and vitamin B complex, only one (Case 1) had the characteristic stomatitis of vitamin B deficiency; furthermore stool examinations in 2 cases failed to reveal any evidence of steatorrhea which is characteristic of the advanced vitamin B deficiency known as the sprue syndrome.

It may be that the syndrome here described is more likely to occur in patients who have some liver damage. This supposition is strengthened by the facts that it has been demonstrated that thiamine deficiency is more frequent in patients with liver disease (4), and that 4 of the 6 patients were chronic alcoholics, another was obese and the sixth patient was under treatment for biliary disease.

The history is probably the best clinical guide in making a preliminary diagnosis of dietary deficiency—although the original history obtained may often be misleading. Few persons who drink large quantities of alcoholic beverages believe that they imbibe to excess so an alcoholic history may be difficult to obtain unless specific questions are asked to elicit this information. Dietary idiosyncrasies also are not reported voluntarily since patients who have them regard them as normal. Hence whenever a nutritional deficiency is suspected a careful dietary history must be taken. As Spies has found nutritional deficiencies are to be suspected in persons whose diets have been inadequate in persons whose utilization and absorption of nutrients seem impaired in chronic alcoholics and in those with dietary idiosyncrasies.

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SUMMARY

The cases of 6 patients with adynamic ileus with severe abdominal distention are reported to call attention to the fact that symptoms suggesting the presence of intestinal obstruction and leading to erroneous diagnoses and unnecessary operations may be caused by thiamine chloride deficiency. In these cases the distention was not controlled by mechanical decompression or administration of prostigmine but responded dramatically to administration of thiamine chloride and vitamin B complex.

In the first case in which the condition was recognized as resulting from vitamin deficiency the patient had a sore mouth which directed attention to this possibility, and specific questions brought to light a history of chronic alcoholism. In this instance a preoperative diagnosis of annular carcinoma of the sigmoid had been made on the basis of obstructive symptoms and the roentgenographic findings but no such lesion was found at operation. However the abdominal distention increased after operation and was not brought under control until vitamin therapy was instituted. The second patient, also an alcoholic, was subjected to celiotomy for acute appendicitis but at operation there was so much intestinal distention that the appendix was not readily accessible and was not removed. When uncontrollable distention continued after operation the experience in the first case was recalled, and vitamin therapy was instituted with equally striking results.

These 2 cases brought to mind 2 earlier cases of severe adynamic ileus of the same type and review of these records confirmed this impression since both of the patients were alcoholics. In one celiotomy was performed because of a mistaken diagnosis of acute appendicitis but no pathologic evidence was found in the appendix to account for the symptoms. Adynamic ileus progressed after operation with severe alcoholic delirium to a fatal outcome. The fourth patient had developed severe distention after an inguinal herniorrhaphy but this patient recovered without the administration of thiamine chloride.

The last 2 patients were not alcoholics, but had been on greatly restricted diets—in one instance for biliary disease, and in the other for weight reduction. In these cases, no operation was performed since nutritional deficiency was recognized as the cause of the distention and response to administration of thiamine chloride and vitamin B complex was striking and complete.

This experience suggests that nutritional deficiency should be suspected and a therapeutic trial of vitamins made in cases of abdominal distention in which the evidence does not justify a positive diagnosis of mechanical obstruction of the intestines. It suggests also that thiamine chloride should be administered at the time of operation to prevent postoperative distention, especially in patients whose nutritional status is at all questionable or in whom there is any suspicion of liver damage.

It is now my routine practice to administer parenterally vitamin B complex with high thiamine content to all surgical patients the day before operation and daily for 3 days after operation. Since this has been done, postoperative distention has been almost entirely eliminated.

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OBSERVATIONS ON THE USE OF GELATIN SPONGE IN CLOSURE OF EXPERIMENTALLY PRODUCED DEFECTS OF THE BRONCHUS

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HEALING of the bronchial stump is recognized as the most important factor in successful pulmonary resection. Rienhoff, Gannon, and Sherman have stressed the importance of healing at the end of the bronchus and have shown that satisfactory closure may be achieved in the dog by airtight approximation of the pleura overlying the bronchial stump. Tafel has shown that airtight closure of tracheal and bronchial defects by patching with free fascial grafts is associated with uniformly successful healing in the dog. The graft acts as a non-viable scaffolding around which the fibroblasts and mucosal cells rapidly reconstruct a new tracheobronchial segment.

Since the primary problem is one of temporary airtight closure while natural reparative processes are at work, the use of an absorbable material for sealing bronchial defects seems logical. The successful use of absorbable agents for hemostasis has now become commonplace.⁽⁴⁾ With such a background, absorbable gelatin sponge has been used during this study in the closure of various defects in the bronchial tree of the dog.

The behavior of gelatin sponge in living tissues has been intensively studied.^(2, 5) Its physical properties have been determined also, but I am aware of no published data on its behavior when used as a barrier to the passage of air. Preliminary *in vitro* experiments showed that moist gelatin sponge was surprisingly resistant to the passage of air. It seemed probable that this material, if it could be kept apposed to an opening in the bronchus, would act as a suitable seal to prevent leakage of air. The procedures outlined in this study were designed to test this hypothesis in the living animal.

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METHODS

Mongrel dogs were used, varying in weight from 6 to 17 kilograms, with the average below 10 kilograms. Diet consisted of dog biscuit and water. Procedures were conducted under endotracheal ether anesthesia, the lungs being inflated rhythmically by a machine while the pleural cavity was open. Silk technique was employed throughout.

The gelatin sponge used was identical with that available commercially in strips 60 by 20 by 7 millimeters. It was prepared for use by moistening in normal saline solution and expressing the excess fluid before application as a patch. In no instance were sutures used to hold the material in position, reliance being placed solely on the action of the surrounding structures and the inherent adhesiveness of the material when moistened with saline and placed in contact with body fluids.

Four groups of experiments were conducted:

1. Test of ability of the material to resist passage of air *in vitro*.
2. Partial transection of the bronchus to the left diaphragmatic lobe and covering the defect with gelatin sponge.
3. Removal of a small segment from the ventral wall of the bronchus to the left diaphragmatic lobe and covering the defect with gelatin sponge.
4. Excision of the upper lobe of the left lung and covering the open end of the bronchial stump with gelatin sponge.

All animal experiments were controlled by production of similar lesions not sealed by gelatin sponge. The operative areas were examined bronchoscopically on many occasions. After certain periods had elapsed the animals were killed by an overdose of anesthetic agent. Water was poured into the opened chest and the lungs were slowly inflated to a point where leakage of air occurred either from the opera-

tive area or from the normal lung parenchyma. Sections of all lesions were examined microscopically.

1 In vitro experiments Commercial gelatin sponge of standard size (60 by 20 by 7 mm.) was moistened with normal saline solution, the material was compressed between the fingers to express the fluid and then tied over the end of a glass tube in the fashion of a drumhead. With the covered end of the tube held under water gradually increasing air pressure was applied within the tube until air escaped through the gelatin sponge.

The tubing used was of three sizes 3, 4, and 7 millimeters inside diameter. With larger tubing it was difficult to secure an airtight seal when using the standard sized gelatin sponge. This material shrinks about 15 per cent on being treated in the manner described.

There seemed to be no constant relation between size of the tubing and the pressure at which leakage occurred. The average pressure required was 40 millimeters of mercury with extremes of 18 and 80 millimeters of mercury in the 15 samples tested. These variations appear to be at least partially related to inequalities in the pores of the gelatin sponge. An unusually large bubble in the material at the site of testing may reduce its thickness in the dry state from 7 millimeters to less than 3 millimeters, and such a thin area might be expected to transmit air at a lower pressure.

When leakage began it would continue despite reduction in pressure. Complete release of pressure and retesting after a short interval however gave values as high as or occasionally higher than the original figure. A variety of *in vitro* tests (such as behavior when moistened with serum or blood) suggest themselves but these points have not yet been investigated.

2 Partial section of bronchus to left diaphragmatic lobe The left chest was entered through the fifth intercostal space exposing the bronchus to the left diaphragmatic lobe. This was separated from the artery and a strip of moistened gelatin sponge placed behind it (Fig. 1). A transverse incision was then made through the ventral half of the bronchus which gaped widely (Fig. 2). The two ends of the gelatin sponge were overlapped to cover this defect. Pressure was applied for about 15 seconds un-

til the ends of the gelatin sponge became adherent by virtue of the blood which was lost on section of the bronchus. The nearby pulmonary artery also played an important rôle in maintaining the position of the material (Fig. 3). No sutures were used. The chest was closed in the usual manner excess air being aspirated through an intercostal catheter which was withdrawn before closure of the skin.

Ten animals were treated in this fashion and all survived without complication until killed under anesthesia at from 1 to 10 weeks.

Three dogs were used as controls. The first of these had undergone a left thoracotomy for another purpose some weeks previously and there were many pleural adhesions. With a knife a 6 millimeter transverse slit was made in the ventral wall of the bronchus to the left diaphragmatic lobe, which gaped very slightly. No gelatin sponge was placed but continuous aspiration of the pleural space was employed during closure and at frequent intervals in the ensuing hour. The animal required no further treatment and remained well until death from another cause a month later. Two animals treated with a slightly more extensive partial bronchial section without gelatin sponge died promptly despite intensive aspiration.

In the first instance it seems likely that aspiration prevented development of a fatal tension pneumothorax until adjacent pulmonary tissue sealed the bronchial opening. Adhesions from the previous thoracotomy may have exerted a favorable effect by preventing the customary gaping of what was admittedly an unusually small bronchial wound.

The microscopic appearance of the repaired bronchus in animals killed at varying intervals after operation confirms previous studies on the healing of tracheobronchial defects. Proliferation of mucosal cells occurred rapidly and a complete but thin epithelial covering might be present in as little as 2 weeks. The meshes of the gelatin sponge were filled with red blood cells in the early stages. These were gradually replaced by macrophages which invaded the periphery and slowly removed the sponge.

In general absorption of gelatin sponge from around the bronchus was slow in comparison with its rate of disappearance when im-



Fig. 1 Showing separation of the pulmonary artery from the bronchus to the left diaphragmatic lobe. A strip of moistened gelatin sponge is being placed behind the bronchus.



Fig. 2 With gelatin sponge in place a transverse slit has been made in the ventral wall of the bronchus to the left diaphragmatic lobe. Insert shows the larger opening after removal of a wedge from the bronchus.

planted in such tissues as omentum or muscle. The structure of the material could still be seen in some specimens 60 days after operation although in other animals it was absorbed much more rapidly. There was ordinarily a minimal polymorphonuclear cell reaction. Sections showed the sponge acting as a plug in the defect while mucosa grew over its internal surface and fibrous tissue invaded its meshes to reform the bronchial wall.

A typical result is seen in the accompanying photomicrograph (Fig. 4a) showing that the gelatin sponge has covered the defect and fitted snugly into the space between the divided bronchial cartilages. In a view under higher magnification (Fig. 4b) one can see beginning epithelial growth at the margins but the gelatin sponge has not been covered after 1 week.

3 Excision of bronchial segment Because of the survival of 1 control dog in the previous group it seemed that mere partial division of the bronchus was not a sufficiently severe test of the method. A second series was therefore studied in which a wedge-shaped section was removed from the ventral wall of the bronchus to the left diaphragmatic lobe. This section included half the circumference of the wall and measured up to 1 centimeter in width at the point of maximal separation (see insert in Fig. 2). Three such control dogs died promptly of tension pneumothorax despite intensive aspiration as in the previous controls.

In 10 dogs the defect was patched with gelatin sponge precisely as in the previous

series and 9 of these survived without complication. In 1 dog considerable difficulty was experienced in maintaining the gelatin sponge in place but no fixation was used except the inherent adhesiveness of the material. As anticipated a small leak developed at the edge of the material and death occurred after 3 days from an infected pneumothorax. It is again emphasized that in all these experiments no sutures were employed to fix the gelatin sponge in place.

The microscopic appearance resembled that in the previous series save that the defects were larger. Figure 5 shows a defect 2 weeks after operation with the mucosa completely but irregularly regenerated. Under the microscope cilia may be seen on the epithelium which is heaped up markedly in some areas. The gelatin sponge is being actively invaded

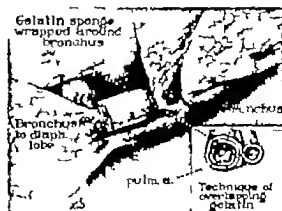


Fig. 3 Bronchus encased in airtight seal of gelatin sponge. Insert shows how the pulmonary artery holds the overlapped sponge in position over the defect.



Fig. 4a. Photomicrograph of bronchus one week after partial resection and patching with gelatin sponge. Note minimal inflammatory reaction and complete sealing of defect. (The dark line is an artefact) $\times 6$.

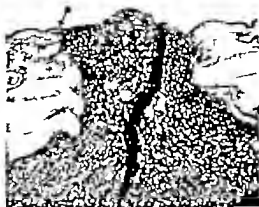


Fig. 4b. Higher magnification of Figure 4a. Epithelial growth has begun at the margins () but there is as yet no covering of the gelatin sponge. (The dark line is an artefact) $\times 9$.

by fibrous tissue and over its surface beneath the bronchial epithellum there is a well organized lamella of loose fibrous tissue.

4 Lobectomy Fifteen dogs were subjected to removal of the left apical lobe, the bronchial stump being covered by a gelatin sponge. Details of the procedure may be seen in Figures 6 and 8. Because of the incomplete fissure between apical and cardiac lobes, a segmental type of resection was usually necessary. After ligation of the vessels and division of the pulmonary tissue the bronchus was severed cleanly without the use of clamps. The open stump was covered by a strip of gelatin sponge

slipped down on either side of the bronchus so that adjoining structures would prevent its displacement (Fig. 8).

Thirteen dogs tolerated the lobectomy well. Nine of these were killed from 3 days to 17 weeks after operation in order to study the healing process. Four are alive and well from 3 to 4 months after operation. Two animals died of empyema on the third and seventh postoperative days. In the first of these an attempt was made to cover the open bronchus by simply laying the gelatin sponge in place on the opening. The rapidly fatal course due to leakage around the gelatin sponge showed this technique to be unsuitable and it was not tried again. The second death occurred after removal of the upper and middle lobes on the left, leaving insufficient surrounding tissue to keep the sponge in position. Two controls in which no seal was placed over the bronchial stump died promptly after operation as soon as continuous aspiration of the pleural space was discontinued.

The manner of bronchial healing after closure by various methods has been discussed at length by Rienhoff, Gannon and Sherman. Bronchi closed by gelatin sponge would be expected to heal in much the same manner as those in which the pleura was simply drawn over the end of the bronchus. In the series of Rienhoff and his co-workers, the main bronchi were under treatment whereas in the present experiments only the bronchus to the left

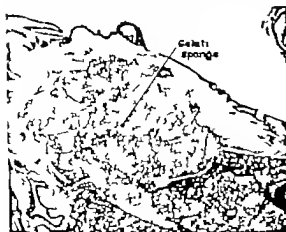


Fig. 5. Photomicrograph of bronchial defect one week after sealing by gelatin sponge. The defect between the cartilages is seen the gelatin sponge covered by connective tissue and irregular bronchial epithellum. $\times 6$.



Fig. 6 Bronchus to left apical lobe isolated after division of pulmonary artery and vein and separation of parenchymal connection with cardiac lobe

upper lobe was considered. However the general principles involved are the same.

Figure 9a is a photomicrograph of the cut bronchus to the left apical lobe sealed with gelatin sponge 3 days before the animal was killed under anesthesia. The gelatin sponge with red blood cells and serum in its meshes is seen to be closely applied to the cut bronchial cartilages. Extending up into the lumen of the bronchus is a loosely organized clot along one edge of which the bronchial epithelium is already beginning to proliferate (Fig. 9b). In another animal 6 weeks after lobectomy the end of the bronchus is seen to be well covered by ciliated columnar epithelium and the gelatin sponge has been replaced by loose fibrous tissue so that no trace of its original structure remains (Fig. 10a and b).

RESISTANCE TO INTRABRONCHIAL PRESSURE POST MORTEM

From the photomicrographs one would infer that the healed bronchi would withstand a considerable pressure of air without leakage. This inference is substantiated by the results of inflation studies of the lungs *in situ* immediately after death. The lungs were inflated under water to a maximum pressure of 80 millimeters of mercury beyond which point leakage generally occurred around the inflated balloon on the endotracheal catheter. Usually the parenchyma of the lung began to leak before this pressure was reached. The pressures

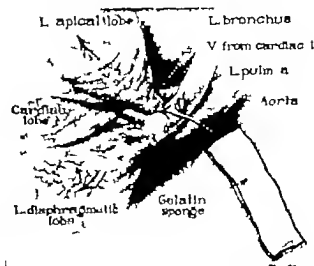


Fig. 7 Left apical lobe drawn medially in order to allow insertion of gelatin sponge between bronchus and pulmonary artery

attained and the results in the various categories are shown in Table I.

In only 1 instance was a leak found at the site of a gelatin sponge patch; this occurred in a bronchus partially sectioned a week previously. The repaired area in this animal transmitted air after the pressure reached 25 millimeters of mercury. In a second animal treated similarly and tested after 1 week the repaired area resisted a pressure of 80 millimeters of mercury. There was considerable variation in the pressure at which the lung parenchyma leaked; in many cases there was no leak at 80 millimeters of mercury whereas one lung from which adhesions had been separated in opening the chest at autopsy leaked at a pressure of 20 millimeters of mercury. As is well known a pressure of only 8 to 10 millimeters of mer-

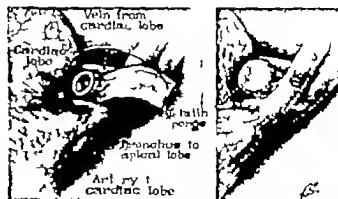


Fig. 8. a, left, Apical lobe removed and one end of the gelatin sponge in place alongside the bronchus. b End of bronchus covered by gelatin sponge.

TABLE I.—RESISTANCE TO
INTRABRONCHIAL PRESSURE POST MORTEM

	Dog No	Time postop	Pressure attained mm. mercury	Remarks
Partial sections of bronchus and gelatin sponge patch	8	week	5	Bronchial wound leaked
	83	week	80	No leak
	5	3 weeks	80	No leak
	26	4 weeks	20	Long paracanthoma leaked
	27	4 weeks	65	Long paracanthoma leaked
	4	4 weeks	65	Long paracanthoma leaked
	24	5 weeks	80	No leak
	7	8 weeks	75	Long paracanthoma leaked
	5	10 weeks	80	Long paracanthoma leaked
	10	3 days	40	Long paracanthoma leaked
Excision of bronchial segment and gelatin sponge patch	30	weeks	30	Long paracanthoma leaked
	40	3 weeks	80	Long paracanthoma leaked
	41	4 weeks	80	Long paracanthoma leaked
	43	5 weeks	80	No leak
	3	6 weeks	75	No leak
		weeks	60	Leak around tracheal catheter
	45	3 days	30	Long paracanthoma leaked
Lobectomy and gelatin sponge patch	43	week	60	Long paracanthoma leaked
	39	weeks	65	Long paracanthoma leaked
	38	3 weeks	70	Leak around tracheal catheter
	37	4 weeks	80	No leak
	36	5 weeks	75	No leak
	3	6 weeks	30	No leak

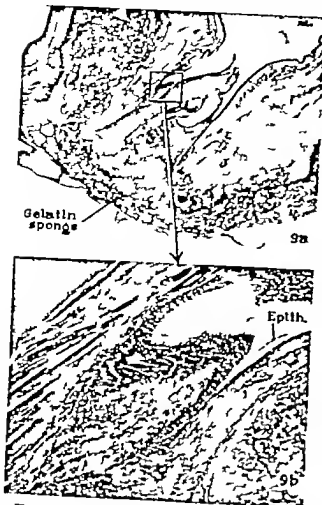


Fig. 9 a. Photomicrograph showing cut end of bronchus 3 days after lobectomy and covering with gelatin sponge. A loose clot lies in the lumen of the bronchus. The contour of the gelatin sponge is readily seen. $\times 6$. b. The bronchial epithelium is beginning to cover the edge of the clot 3 days after operation. $\times 63$.

curry is required for full expansion of the lung in the dog

DISCUSSION

It is apparent that in the dog bronchial openings produced in a variety of ways may be healed successfully by the use of gelatin sponge without suture fixation. In 10 partial sections of the bronchus to the left diaphragmatic lobe all animals survived when a patch of gelatin sponge was used. As a more severe test of the method it was employed after removing a segment of the ventral wall of the bronchus to the left diaphragmatic lobe in 10 animals. All but one of these healed satisfactorily. Fifteen dogs

were subjected to removal of the left apical lobe, with gelatin sponge as the only covering for the bronchial stump. Thirteen of these survived. The 3 deaths in the two latter groups occurred as a result of infection, presumably originating in the open bronchus.

Microscopic study of the operative areas showed organized fibrous tissue well covered by epithelium. In bronchi not deformed by suture of the cut edges the tissues seemed to achieve a smooth, firm union fairly rapidly.

In the course of segmental or total lobectomy in man, one occasionally encounters a partial severance of an adjoining bronchus. The repair of such accidental bronchial lesions presents a difficult problem particularly when a wedge of bronchial wall has been removed. Suture of such a lesion may deform the bronchus and lead to atelectasis and suppuration



Fig. 10 a, left, Six weeks after lobectomy the end of the bronchus is firmly sealed and there is no trace of the gelatin sponge. $\times 6$ b Higher magnification of Figure 10a. Normal epithelium is seen covering the end of the bronchus. The underlying connective tissue is very loose. $\times 69$

distal to the area of repair. It seemed that a patch of absorbable material placed over such a lesion would be more conducive to healing without deformity than any other method. Such a clinical possibility prompted the studies detailed here. Results were fairly successful even though the gelatin sponge was not sewed in position. With suture fixation it seems likely that better results could be achieved and the safety of the method could be increased to a point at which clinical trial might become advisable.

The present studies demonstrate merely the validity of the concept that an absorbable material may be used for closure of experimentally produced openings in the bronchi. However, it must be stated emphatically that the particular technique described here is not recommended for clinical use. This technique purposely omitted factors which might have been expected to enhance its safety in order to provide a more rigorous test. Moreover, the results in animals, even if perfect, cannot be used except as an indication of possible clinical applicability. As Bailey(1) has aptly stated

it must be recognized that closure of the bronchus in animals is only slightly comparable to the problem as met in clinical human cases. A momentary consideration of the smallness of the bronchi in animals, the absence of previous bronchial or pulmonary infection, the absence of previous pleural adhe-

sions, and the great mobility and redundancy of the mediastinum will indicate the contrast. The studies of Rienhoff and others on closure of the bronchial stump by mere approximation of the pleura over it lend further support to this view.

There are currently a number of accepted methods for bronchial closure. Most of these recognize certain principles in bronchial healing among which are the preservation of the blood supply by avoidance of crushing clamps or constricting ligatures and the pleuralization of the occluded bronchial stump. Sweet has reported 140 instances of bronchial closure with only 1 known failure. It would certainly be rash at present to suggest the clinical use of the method as described here when results under relatively ideal experimental conditions are not as satisfactory as those of Sweet just noted.

However, the danger of deformity or stenosis following the usual type of repair in accidental bronchial wounds suggests that a modification of the present gelatin sponge method may be helpful in such accidents. Its use in conjunction with standard methods of bronchial closure after pulmonary resection must also be considered. Moreover, with increasingly radical removal of neoplasms involving the carina or lower trachea, the need for a satisfactory technique of repairing such defects is apparent. The ingenious work of

Daniel in this connection is a striking example of one approach to the problem. He replaced entire segments of the tracheobronchial tree in dogs with glass tubes and removed the tubes bronchoscopically many months later at which time tracheobronchial continuity had been restored. The use of absorbable materials in a similar connection is an attractive possibility that is now under investigation in this laboratory.

SUMMARY

Absorbable gelatin sponge has been used as a seal for various experimentally produced bronchial defects in dogs.

In 10 dogs a transverse partial section of the bronchus to the left diaphragmatic lobe was sealed by gelatin sponge with uniformly good results.

In 10 dogs a segment was removed from the ventral wall of the bronchus to the left diaphragmatic lobe the defect being covered with gelatin sponge. All but 1 of these dogs recovered.

In 15 dogs the apical lobe of the left lung was removed the bronchial stump being cov-

ered with gelatin sponge. Thirteen of these recovered.

In no instance were sutures used to hold the gelatin sponge in position reliance being placed solely on the retaining effect of adjoining structures plus the adhesive qualities of the material when moistened with body fluids. By the use of suture fixation one would expect increased reliability of the technique.

Although the present technique is not advised for use in patients, the general principle of sealing bronchial defects by absorbable material may have clinical applicability.

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DISCREPANCIES IN MYELOGRAPHY

Statistical Survey of 200 Operative Cases Undergoing Pantopaque Myelography

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M.D. Salt Lake City Utah and WALTER DOUGLAS HANKINS M.D.,
Johnson City Tennessee

MANY excellent articles have extolled the virtues of pantopaque and other contrast myelography in the study of the ruptured intervertebral disk (4 5 6 7 13). This article attempts to point out certain limitations of this diagnostic method and represents a survey of 200 operative cases from Cushing General Hospital in 1944-1945.¹ In the discussion 2 additional unpublished surveys will be included for the sake of comparison. The survey was undertaken when the neurosurgical author (W.B.S.) and several independent roentgenologists (author W.D.H. Danelius and Ogden) commented on the difficulty in making a clear cut diagnosis of the presence or absence of a ruptured disk by myelography alone. It was our collective impression that myelography yields equivocal findings in at least 25 per cent of the cases. If true this was at variance with published statistics.

LITERATURE

Statistical surveys of which there have been many (4 6 8 13) give an overall accuracy of 92 to 93 per cent in contrast myelography regardless of the media used. When analyzed such statistics are erroneous as they are based on positive myelograms only; those cases of normal myelograms which nevertheless reveal a ruptured disk at operation being ignored. This was commented upon by Pugh. Only recently have surveys (1 2 15 16) suggested a higher percentage of error and only Maltby and Pendergrass have devoted an entire and excellent article to the diagnostic errors found in myelography. However no

corrected statistics have been published yet to supplant the older euphemistic reports.

The causes for error have been well described (12) and include (1) double disks which occur in 12 to 14 per cent (4 16);² (2) a high cul-de-sac (1 6 14 16); (3) a giant canal; (4) a congenitally narrow dural sac; (5) post-operative defects and adhesions; (6) so called subclinical protrusions or hidden disks of Dandy consisting of a torn annulus with fragmentation and degeneration of the nucleus pulposus and occasionally cartilaginous plate but without actual protrusion. Too much stress has been laid on thickened ligamenta flava and varices and too little on that most common cause of error a lumbosacral "disk" situated so far laterally as to give no dural or root sheath defect at all (1). Disagreement exists on the diagnostic importance of asymmetry of root sheaths. Horwitz gives us all food for thought in his study of 100 autopsied spines in which he found that asymptomatic multiple protrusions with actual degeneration of the nucleus pulposus are a common occurrence throughout the adult spine.

SURVEY

Two hundred consecutive cases in which patients were subjected to pantopaque myelography and operation for a lumbar ruptured intervertebral disk were studied at the Cushing General Hospital. That technique now generally accepted throughout the United States was used for pantopaque myelography (11 17). Spot films were taken in both postero-anterior and oblique views in all cases. Lateral views were omitted because of technical

¹From the Neurosurgical Service of Wm. P. Van Wageningen, M.D. and the Roentgenological Service of Walter D. Hankins, M.D. Cushing General Hospital, Framingham, Massachusetts.

²In a recent survey of 100 civilian operative cases at the Hartford Hospital, a ruptured disk was found in 90 per cent, a "hidden disk" with true degeneration and fragmentation of the nucleus in 3 per cent, double disks in 5 per cent.



Fig. 1



Fig. 2



Fig. 3

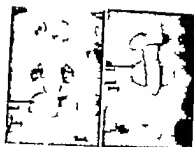


Fig. 4



Fig. 5

Fig. 1. A left lumbosacral ruptured disk. Incorrectly diagnosed as normal. A major error.

Fig. 2. A left lumbosacral ruptured disk. Incorrectly diagnosed as normal in both semiprone and vertical positions. A major error.

Fig. 3. A right lumbosacral ruptured disk. Incorrectly diagnosed as normal. A major error.

Fig. 4. A ruptured disk found at operation. Incorrectly

diagnosed as root sleeve defect, right lumbosacral. A major error. Compare with Figures 1, 2, and 3 in which ruptured disks were found at operation although myelogram showed no gross defect.

Fig. 5. A left lumbosacral ruptured disk. Correctly diagnosed as minimal root sheath asymmetry, left lumbosacral. No error. Compare with Figure 4 having similar type of defect with negative exploration.

difficulties and lack of agreement as to their advantage over oblique views (3-9). Operation was carried out because of clinical evidence of a ruptured disk plus a considerable physical disability. In this series more patients with mild symptoms underwent operation than would have been operated upon in civilian life because of that universal G. I. tendency to turn in at the first hint of disability. All myelograms were reviewed jointly by the roentgenologist and neurosurgeon without knowledge of the clinical or operative findings. Comparison was then made between the myelographic diagnosis and the operative findings.

A positive finding at operation was defined as (a) a frank herniation of degenerated nuc-

lear fragments through a torn annulus or (b) a marked 'bulge' of the annulus, with softening and a true 'stringy' degeneration and fragmentation of the nucleus and at times fragmentation of the cartilaginous plate. The so-called 'hidden disk' of Dandy was excluded as were tumors simulating ruptured disks.

Errors in diagnosis were divided into *major* and *minor*. Major errors constituted those in which the myelographic diagnosis was in direct contradiction to the operative findings, i.e. a myelogram incorrectly diagnosed as normal or as abnormal. Minor errors included (a) errors in localization either by interspace or lateralization, (b) errors in differentiation between single and double disks, and (c) errors of technique.

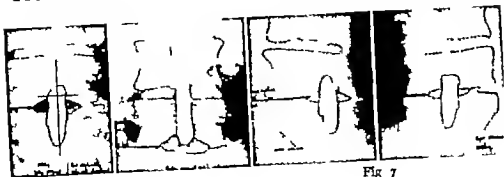


Fig 6

Fig 7

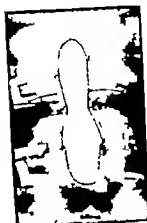


Fig 8.



Fig 9



Fig 10



Fig. 11

Fig 6 A left lumbosacral ruptured disk. Incorrectly diagnosed as right lumbosacral. A minor error of lateralization.

Fig 7 Oblique views of Figure 6

Fig 8 Normal physiological constriction frequently found at third lumbar interspace. No error made. Compare with Figure 9.

Fig 9. Double "disks" at left fourth lumbar and lumbosacral interspaces although no apparent defect is visible at left fourth lumbar. A minor error. Compare with Figure 8.

Fig 10 No ruptured disk found at operation. Defect at left fourth lumbar interspace incorrectly diagnosed as a ruptured disk. A major error. Compare with Figure 7.

Fig 11 Double "disks" at left lumbosacral (picture on left) and left fourth lumbar interspaces (picture on right). Defect at fourth lumbar (picture on right) was incorrectly diagnosed as a normal physiological variant. A minor error. Compare with Figure 10.



Fig. 12

Fig 12 A left lumbosacral ruptured disk. Defect at left fourth lumbar interspace was incorrectly diagnosed as an additional double "disk." A minor error. Compare with Figures 7 8 9 and 11.

RESULTS

1 Four cases of lumbar spinal tumors were excluded from our statistics.

2 Ruptured disks were found in 173 or 88 per cent of the remaining 196 patients operated upon. Findings in the 23 other cases were



Fig. 3.



Fig. 7.



Fig. 8.



Fig. 6.



Fig. 17.



Fig. 9.

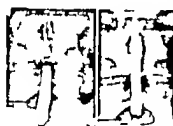


Fig. 15.



Fig. 30.

Fig. 3. A left lumbosacral ruptured disk. Defect at fourth lumbar interspace was incorrectly diagnosed as an additional double disk. A minor error. Compare with Figures 7, 8, 9, and 14.

Fig. 14. A right fourth lumbar ruptured disk. N. error. Case shown for comparison with Figure 3 which had an exactly similar defect without the presence of ruptured disk at this location.

Fig. 15. A left central fourth lumbar ruptured disk. N. error. Compare with Figure 3.

Fig. 6. A right fourth lumbar ruptured disk. The only case in this series in which the disk was demonstrated on oblique view but not in posteroanterior view. N. error. (Since completion of this series, oblique views have been discontinued except when prone posteroanterior view

falls to show defect.)

Fig. 7. A left lumbosacral ruptured disk. Congenital giant canal (6 c.c. used). Incorrectly diagnosed as normal. A major error.

Fig. 8. A right lumbosacral ruptured disk. Congenital high cul-de-sac (even in upright position). Incorrectly diagnosed as right fourth lumbar disk and a normal lumbosacral interspace. A major error.

Fig. 9. A left lumbosacral ruptured disk. Congenital narrow dural canal which often fails to demonstrate a laterally situated ruptured disk. Incorrectly diagnosed as normal. A major error.

Fig. 30. A left lumbosacral ruptured disk. A technical error with failure to center the dye exactly over lumbosacral interspace. Incorrectly diagnosed as normal.

swollen nerve roots adhesions bony ridges one fractured facet and, more commonly nothing. Double disks were found in 11 per cent.¹

¹See footnote² first page of article.

3 Overall errors in myelographic diagnosis occurred in 65 out of 196 cases, or 33 per cent.

4 Major errors occurred in 32 or 17 per cent, of 190 cases (omitting 6 cases of technical error out of the 196 cases). They consisted of



Fig. 21



Fig. 22



Fig. 23



Fig. 24

Fig. 21. A left lumbosacral ruptured disk. Incorrectly diagnosed as normal. A major error. In addition a needle defect is demonstrated at right third lumbar interspace which continues after withdrawal of the needle. A frequent cause of technical diagnostic error to the uninitiated.

Fig. 22. A right fourth lumbar ruptured disk. No diagnosis was made because of subdural location of dye as

shown by sluggish flow and "islands" of dye remaining after withdrawal. A minor technical error.

Fig. 23. No diagnosis made because of epidural location of dye. A minor technical error.

Fig. 24. A right fourth lumbar ruptured disk. No diagnosis, because of irregular filling, occasional even when dye lies within subarachnoid space. A minor technical error.

25 or 13 per cent *false negative* and 7 or 4 per cent *false positive* cases. All but one of the false negatives yielded disks in the lumbosacral interspace at operation.

5 *Minor errors* occurred in 33 or 17 per cent of 196 cases. They consisted of 6 or 3 per cent, errors in *technique* and 27 or 14 per cent errors in *localization*. Errors in localization were further subdivided: 6 per cent were due to mistakes in the localization of a single disk; 5 per cent were due to double myelographic defects with a single disk found at operation; and 3 per cent were due to a single myelographic defect with double disks found at operation.

DISCUSSION

In order to rule out the personal equation from these diagnostic errors a comparison was made with an independent survey carried out under identical conditions in 1945 to 1946 by Drs. Gerhard Danelius and Frank Turney, respective chiefs of the roentgenological and neurosurgical services at McCaw General Hos-

pital. They have kindly permitted their results to be quoted in this article and it is to be hoped that their painstaking survey will be published as a separate article. Their results were roughly comparable with the exception that their major errors were less than one-half of ours. Overall errors were 24.4 per cent; major errors were 7 per cent; minor errors were 21 per cent including 9 per cent of technical errors.

For further comparison a small survey of 25 consecutive civilian cases was carried out at the Hartford Hospital in 1946 by Dr. Ralph Ogden, roentgenologist and the author (W.B.S.). More rigorous preoperative clinical criteria as well as operative criteria were used with the result that only one negative exploration was performed and operative findings revealed the presence of actual herniation of disk fragments through the annulus fibrosus in every other case. In spite of these criteria and the benefit accruing to the author from his experience gleaned in the other series the results were again comparable to the original survey.

Overall errors were 28 per cent major errors were 12 per cent minor errors were 15 per cent There were no technical errors. Double disks occurred in 1 case or 4 per cent

Our high percentage of error in myelographic diagnosis as compared to previous reports is apparent rather than actual. If our statistics shall be limited as they are in the older articles to only false positives (i.e. those myelograms incorrectly indicating the presence of a disk not found at operation) and to technical errors the percentage of discrepancies in our survey will be exactly comparable to those previously reported namely 7 per cent or an accuracy of 93 per cent

From a detailed analysis of our survey it appears that the largest percentage of error occurs in those myelograms incorrectly diagnosed as normal. In fact if operation shall be performed upon all cases having clinical evidence of a disk but a normal myelogram an error in myelography will be found in 74 per cent of those cases. Twenty four of 25 cases in thus 74 per cent will reveal a laterally placed lumbosacral disk at operation. The second largest percentage of error occurs in the false localization of single disks. These 2 groups together cause 50 per cent of all myelographic errors. In contradistinction technical errors are few and the positive myelograms will be correct in 95 per cent of the cases

With the above in mind these writers will continue to use pantopaque myelography routinely on all ruptured disk suspects but will tend to discount all normal myelograms if contradicted by the clinical findings.

CONCLUSIONS

1 Clinical evidence of a ruptured disk is more important than is myelographic evidence.

2 A positive myelogram is more important than a negative myelogram. A negative or normal myelogram in the face of clinical evidence of a ruptured disk will be wrong three out of four times

3 Myelography fails to rule out the presence of a laterally placed lumbosacral disk. In 24 of 25 cases of ruptured disk in which the

myelograms are normal, the location is in the lateral lumbosacral interspace.

4. Root sheath asymmetry is an important yet equivocal myelographic sign which may or may not indicate the presence of a ruptured disk. It is of little value without confirmatory clinical evidence.

5 Myelographic double defects are more common than are actual double disk ruptures or herniations.

6 When myelography is used as the sole diagnostic criterion the overall error is in the neighborhood of 25 to 35 per cent in contrast to the 6 to 8 per cent cited in the literature.

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WOUND HEALING IN EARLY AMBULATION

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THE recent work of Leithauser (3) has refocused attention in this country on the advantages of early postoperative ambulation. This method of treatment has often been a source of doubt in the minds of surgeons who naturally might fear a disturbance in wound healing especially after laparotomy. The possibility of rupture of the abdominal wound or subsequent herniation has long been a hindrance toward getting patients out of bed soon after operation despite reports (5) which specify that in case of wound rupture the majority of these accidents occur before the patient becomes ambulatory.

This work was designed to compare the tensile strength of abdominal wounds of a group of dogs exercised daily after operation with a similar group closely confined. The conditions reproduced as nearly as possible those of patients treated postoperatively by bed rest and by early ambulation.

METHOD

In healthy well fed dogs weighing between 6.5 and 14.0 kilograms right rectus muscle splitting incisions into the abdominal cavity were made under aseptic precautions. The incisions which averaged 8.0 centimeters in length, were placed midway between the xiphoid and the symphysis and were sufficiently long to yield enough material at suture line for duplicate determinations of tensile strength and for microscopic study. Transverse upper rectus incisions were made in 2 dogs.

After difficulty in obtaining wounds completely free of infection in the beginning of the experiment the abdomens of all animals were clipped on the day prior to operation and washed with a detergent. This preoperative preparation reduced stitch hole abscesses to

infrequent occurrences. On day of operation the abdomens were shaved scrubbed with soap and water and then painted with iodine and alcohol.

The incision was carried down through the peritoneum and staggered in the several layers so that the lines of incision were not superimposed. The wounds were handled gently without the aid of retractors and clamps were applied only for suture of the peritoneum posterior rectus layer. Suture material consisted of No. 0000 silk except for a few animals in which part of the sutures were No. 000 plain catgut. Continuous sutures of silk were used in the peritoneum posterior rectus fascia anterior rectus fascia, and subcutaneous tissue. A continuous subcuticular suture was used for skin closure, with an occasional interrupted external skin suture for perfect coaptation. Collodion was the only external dressing in most of the animals. External sutures were removed by fourth to sixth day. After preparation of segments of tissue for the tensiometer the silk was extracted from the suture line.

On the day of operation the animals were weighed and blood serum protein levels were determined by the copper sulfate method (7). At the time of sacrifice all dogs with the exception of a few, were again weighed and the serum protein levels determined.

Maintenance of protein and caloric intake was kept very high but metabolic studies were not done. All animals were given and observed to eat a dietary of bread, fresh milk, beef and commercially prepared dog food.

Twenty six animals were operated upon and used for the experiments. The wounds of all were free of infection although small isolated hematomas were present in six. The protocols of these animals were included since the tissue to be tested was separated by several centimeters of normal tissue and the tensile strength was not considered to be affected. After operation 2 groups of 13 each were

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Fig. 1. Die fitted with razor blades to cut centimeter wide segment of skin (Zantel's method personal communication)

formed. The animals of one group, the control, were confined to metabolism cages, the small dimensions of which afforded little opportunity for movement (2 by 3 feet). Those of the other group, the experimental one, were not only allowed free movement in a large pen but were also exercised at regular intervals including the day of sacrifice. The exercise begun on first postoperative day was given in 20 minute periods twice daily. During each exercise period animals were raced up and down several flights of steps and then taken

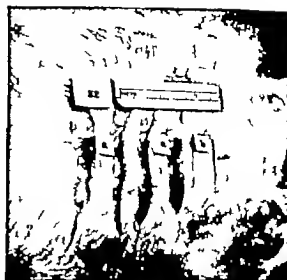


Fig. 2. Segments of anterior abdominal wall skin of dog, cut with die completed to show contraction. A "scoring" of skin as a preliminary step before the deeper cut is made. Anterior rectus fascia and peritoneum-posterior rectus layer were treated in like manner. Eight days postoperative.

out of doors for a run. Each dog was also danced around on his hind legs several times.

The animals of both groups were killed by intracardiac ether injection with the day of sacrifice taking place at intervals of 4, 6, 8, 10, and 14 days after laparotomy. A few were killed on the thirteenth and sixteenth days. Two transverse segments each of skin, anterior rectus fascia and peritoneum-posterior rectus fascia, were excised so as to include the vertically placed suture line in the center of the strip (Figs. 1 and 2). The tensile strength was then determined on the tensiometer as described by Meade from a modification of the technique of Howes, Sooy, and Harvey (Fig. 3). The two readings on each layer of tissue were averaged and a single value obtained. Sections of each layer were removed for microscopic study.

The unit of measurement of the tensiometer is grams, and since all tissues were cut so that the width at the suture line was 1.0 centimeter, the tensile strength of the tissues is then recorded as grams per centimeter. A small error in cutting the tissue so that it becomes wider or narrower than the standard may mean a large difference in tensile strength. Care was taken to remove the segments of tissue after



Fig. 3. Segment of skin in tensiometer ready for determination of tensile strength.

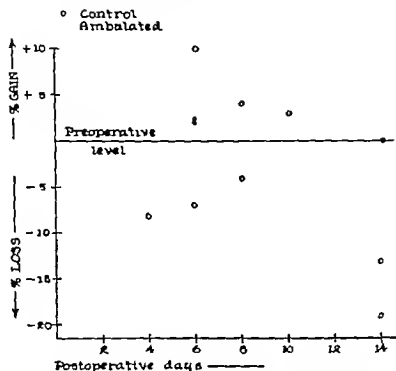


Fig. 4. Postoperative weight changes in ambulated and control animals.

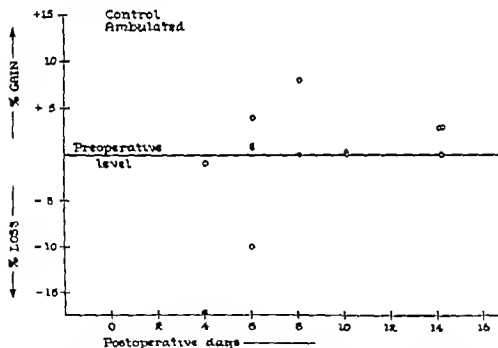


Fig. 5. Postoperative serum protein changes in ambulated and control animals.

death in the intact animal under normal skin tension

GENERAL CONDITION OF ANIMALS

In the experimental group the animals were reluctant to walk during their first period of exercising. It was only with difficulty that

they could be kept moving for the full 20 minutes. By the time of the second exercise period on the first postoperative day the animals were anxious to be put on the leash and their physical strength appeared to be increased. The animals of the control group remaining in cages were otherwise given the

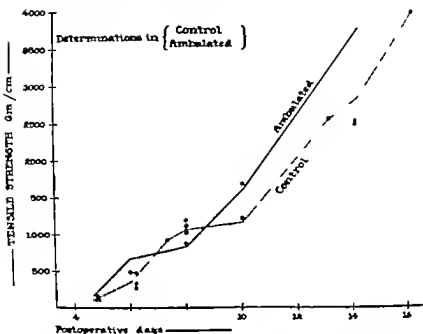


Fig 6 Determination of tensile strength of skin wounds in ambulated and control animals

same individual attention. The difference in the amount of exercise amounted to more than that of the two daily exercise periods since the ambulated group moved freely around their large room while those in cages were disinclined to move except at times of feeding and cleaning out of their quarters.

The advantages of early postoperative ambulation which have been described in man in numerous reports (4) have their counterpart in the dog. In every instance the animals of the ambulated group in contrast to those in confinement, were more lively and kept their coats in cleaner condition. Smoother function of the gastrointestinal tract was indicated by heartier appetites and more regular and thorough defecation. Often the control dogs would be constipated for a few days but this was never noted in the ambulated group.

CONDITION OF THE WOUNDS

Gross examination of the wounds disclosed no differences between the two groups. The incisions appeared the same as in other healthy animals not subjected to the conditions of this experiment. There were no wound ruptures or evidences of gross infection. Three small hematomas occurred in each group but since

these were well localized and isolated it was considered that the tensile strength of these wounds was not affected. The hematomas occurred in wounds in which hemostasis was difficult to accomplish; their presence was due to errors in operative technique rather than to the effect of early postoperative ambulation.

The weights of 19 animals on the day of operation and on the day of sacrifice were recorded (Fig 4). Nine of these animals were in the control group and of these 9 only 3 animals showed a gain in weight over the course of the experiment. At one extreme one animal sacrificed on the sixth day gained 10 per cent over his preoperative level and at the other a loss of 19 per cent was observed on the fourteenth day. In contrast of the 10 animals in the ambulated group with data on weight, only 2 lost weight. One of these dogs developed diarrhea from overeating fresh meat.

In 23 animals blood serum protein levels were determined on the day of operation and at sacrifice (Fig 5). The preoperative values were at 5.4 grams per 100 cubic centimeters or above. Of 12 in the control group 2 were reduced below the preoperative level. Both of these animals lost weight. In the ambulated group the levels in 4 animals were low at the

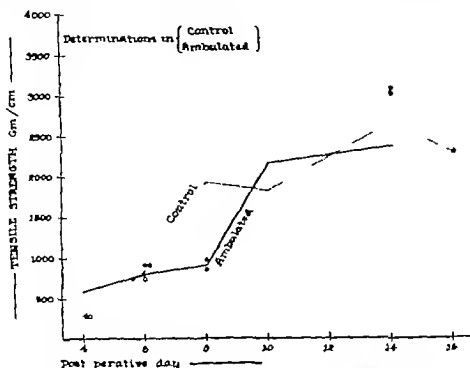


Fig. 7. Determination of tensile strength of anterior rectus fascia wounds in ambulated and control animals.

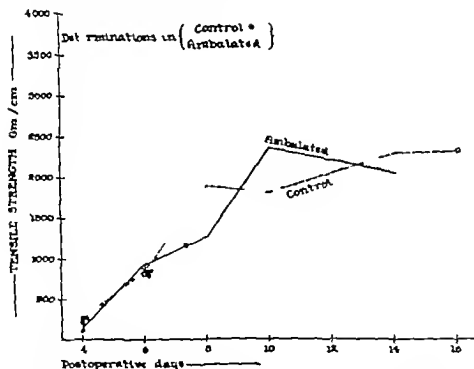


Fig. 8. Determination of tensile strength of peritoneum-posterior rectus fascia wounds in ambulated and control animals.

time of sacrifice, and of these only 2 also lost weight.

TENSILE STRENGTH

The tensile strength determinations were plotted so that similar tissues could be com-

pared in the two groups. The mean curves in Figures 6, and 8 show that the strength of the wounds in the ambulated group closely matches that in the control group. The approximate coincidence of curves is true of skin



Fig. 9. Dog 235. Healing wound of anterior rectus sheath. Early ambulation. Fourth postoperative day showing profuse growth of fibroblasts across wound gap. F and F indicate cut edges of fascia. $\times 45$.

anterior rectus fascia, and peritoneum posterior rectus fascia. In fact, not only the curves but also the actual values are nearly identical with those in the original report in 1929 by Howes, Sooy and Harvey. Consequently the strength of the three important layers of the abdominal wall is neither increased nor weakened by early postoperative exercise.

HISTOLOGY

On histological examination no differences could be found between the control and ambulated groups of animals. The process of fibroplasia was well advanced by the fourth postoperative day and fibroblasts were abundant throughout the several layers of tissues. By the fourteenth day the scars were well organized and vascularized (Fig. 9).

DISCUSSION

Since epithelization is of minor significance in aseptically incised and primarily sutured wounds Howes, Sooy and Harvey have shown that the single factor of repair by fibrous tissue can be measured accurately enough for analysis by determining the tensile strength at intervals after operation. Any change in healing of the cleanly sutured abdominal wound must then be demonstrated by an effect on the latent or lag period, the phase of fibroplasia or maturation. The strength of the wounds in this experiment on the fourth postoperative day is sufficiently great to eliminate early ambulation as a cause of prolonging the latent

period. The period of fibroplasia is characterized by an abrupt rise in strength of a sort consistent with the 'normal' curve of wound healing by this method. Study of the phase of maturation was incomplete since our interest lay in the condition of the wounds in the early days after primary closure during the time when wound rupture is most common. Kimbarovskiy in 1940 performed an experiment on dogs in which he found that the wounds of animals placed in casts showed delay in connective tissue formation when compared with others that were ambulatory. Newburger reported increased strength of abdominal wounds in rats exercised daily on a treadmill. The results obtained by these investigators cannot be accurately correlated with the present work due to the wide difference in experimental conditions.

SUMMARY AND CONCLUSIONS

1. Studies of serum protein, weight change and tensile strength of the abdominal wound were performed in 26 dogs.

2. One half of the animals were kept inactive after operation and the others were treated by early postoperative ambulation.

3. Comparison of the two groups is as follows:

a. The general condition of the ambulated animals was improved over that of the controls.

b. A significant number of animals in the ambulated group gained weight while the controls generally lost weight.

c. The tensile strength of the postoperative abdominal wound in the ambulated group did not differ significantly from the values in the control group.

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DIFFERENTIAL SPINAL BLOCK

IV The Investigation of Intestinal Dyskinesia, Colonic Atony, and Visceral Afferent Fibers

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THE occurrence of disordered motor states of the intestine as a puzzling incapacitating and occasionally fatal syndrome has long been recognized. Murphy in 1896 reported spasm of the bowel simulating acute mechanical intestinal obstruction in a painter. This report was followed by 3 cases of spastic ileus from Heidenhain's Clinic in 1897 and by 1910 protocols were available on 51 cases in which spasm was sufficiently pronounced to cause obstructive symptoms in the absence of organic mechanical interference with the lumen (16a). Engstad in 1928 reported 6 cases of spastic ileus of the jejunum verified by operation. Zimmerman in 1930 added 2 cases of his own to the 157 available cases in which spasm of the bowel was thought to be the cause of obstruction. The following year Christianson and Borgen published 5 cases that had abdominal distention, cramps and vomiting for which no mechanical cause could be found. Steigmann and Singer published the protocol of one case of idiopathic neurogenic spastic ileus which terminated fatally and cited 14 similar fatal cases. Colp in 1941, reviewed the literature on spasm of the colon as a cause of intestinal obstruction and published protocols of 5 cases of his own. White and Smithwick published the report of a most interesting patient with intermittent periods of vomiting, severe constipation, increased peristalsis and pain coming in waves. Four laparotomies had not been of help. Paravertebral procaine injections conferred relief and the ensuing sympathectomy was successful. Chesterman in 1946 elaborated on the Alvarez theory of intestinal

gradients to explain the cases of neurogenic ileus that had come to his attention. The articles mentioned and their appended bibliographies comprise the available literature on the clinical aspects of spastic ileus.

It is admittedly difficult to evaluate some of the reviewed cases in terms of whether or not actual spasm was the sole cause of the patient's disease. Nevertheless enough well authenticated and directly observed material is available to ensure the importance of deranged intestinal motor function as a surgical syndrome. And yet, only rarely is it considered as a part of the differential diagnosis when crampy abdominal pain, persistent obstipation, abdominal distention and tympanites are encountered.

One of the underlying reasons for this is the fact that it is frequently difficult or impossible to make the diagnosis of neurogenic intestinal obstruction preoperatively. When a patient recovers from a bout of obstruction either spontaneously or with the help of intestinal intubation, the intestine is said to have unlinked or the edema subsided, allowing reestablishment of intestinal transport.

The use of a sympathetic block to alter bowel motility and transport was first suggested by Wagner in 1919. Eight cases of abdominal distention responded well to splanchnic anesthesia with procaine. Since then splanchnic or spinal anesthesia has been used many times in intestinal distention of varying sorts and with varying success (7). The laboratory experiments of Domenech, David and Loring, Markowitz and Campbell and Ochsenrider, Gage and Cutting have put on a firm physiologic basis the value of interrupting the sympathetics in relieving the paralytic ileus induced by chemical or bacterial peritonitis.

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The latter authors justifiably wondered why spinal anesthesia did not yield equally consistent results in the human. This point we believe has been resolved by the significant work of Helm and Ingelfinger (12-13). These investigators have convincingly demonstrated that morphine and atropine, presumably by a direct effect on the bowel, can prevent the increase in intestinal motility induced by spinal anesthesia. It is likely that an appreciable proportion of patients who have received spinal anesthesia for paralytic ileus were under the influence of either or both of these drugs. The importance of withholding medication when attempting to use spinal anesthesia to increase bowel motility and transport cannot be overemphasized.

For the most part spinal anesthesia has been used in *paralytic* ileus and has been used as a therapeutic measure. The classical clinical observations of Scott and Morton and of Smithwick (28) constitute the only attempts, of which we are aware to use it as a prognostic index in disordered motor states of the intestine. These workers concluded that if a spinal anesthesia, properly administered, induced motility and transport in an otherwise dilated and nontransporting colon, resection of the appropriate sympathetic fibers should cause clinical improvement. Smithwick also used a paravertebral block for the same purpose (28).

This report concerns itself with observations concerning the effect of blocking sympathetic visceromotor fibers on bowel activity and transport. It indicates the usefulness of a particular type of sympathetic block, differential spinal block (18-19, 20, 21) as a therapeutic measure in non-mechanical obstructions. Perhaps of more significance than the above are the data which indicate the usefulness of sympathetic blocking procedures in differentiating intestinal dyskinesia with a neurogenic component from the common type of acute mechanical intestinal obstruction.

MATERIAL AND METHOD

All patients were from the surgical services of the Massachusetts General Hospital. Five patients were given a differential spinal block in an attempt to alter temporarily bowel func-

tion. Two additional patients had the visceral afferent pathways (carrying the sensation of distention) tested while under the influence of a high differential block.

The technique of administering a differential spinal block has been previously described (18-19, 20, 21). Briefly it consists of the subarachnoid administration of a large volume of a dilute solution of procaine hydrochloride (0.5%). This is delivered from an elevated leveling bulb through a calibrated drip chamber to an infusing needle in the third lumbar interspace. The optimal initial dose is 16 cubic centimeters administered in about 4 minutes. The drip is then continued at the rate of 16 drops per minute until the desired block is accomplished. The drip is subsequently set at that rate which will maintain the block until it is no longer required.

The use of this technique has made it possible to produce a sympathetic block and a block of the fibers concerned with pinprick sensation without grossly affecting touch, position sense, vibratory sense, or motor power. The effect of this type of block on visceromotor function has not previously been investigated.

The distention stimulation of the jejunum and rectum was kept within constant limits by elevating the pressure within the intestinal balloon in a constant fashion. The balloon pressure was elevated to a given level by a given volume of air delivered in a given time.

The four balloon intestinal tube was constructed so that each balloon was placed 10 inches from its neighbor and led to recording pens via separate tubes. In this way a peristaltic wave starting in terminal ileum could be traced around to descending colon by the impression it made on each of the four balloons it passed (Fig. 1a). This apparatus will be described in detail in a separate communication (1).

PROTOCOLS

CASE 1: The first patient was a 38 year old married housewife, who was first seen in this hospital in 1933. Ten years previously an appendectomy had been performed following repeated attacks of right lower quadrant pain. The postoperative diagnosis was congenital adhesions. In 1940 the patient was said to have had acute intestinal obstruction and a lysis of adhesions was performed.

In July of 1933 while 6 1/2 months pregnant the patient was admitted to this hospital for the first time with cramp-like abdominal pain, nausea, and vomiting. This pain subsided spontaneously but recurred one week later and was accompanied by fecal vomiting and abdominal distention. A lysis of adhesions was performed under ether anesthesia but severe distention persisted for a week, and an ileostomy had to be performed at the end of that time. This relieved the patient completely and recovery was prompt. At the first operation it was thought that the point of obstruction had been freed but at the time of the ileostomy 10 days later the small intestine was again seen to be severely distended.

In November 1934 a cholecystectomy was performed following 3 severe attacks of right upper quadrant pain. Gall stones were found at operation. Soon after discharge a mental depression set in, and in January 1936 the patient was readmitted for psychiatric attention.

The cramp-like abdominal pain, vomiting, and distention reappeared after increasing bouts of constipation in July 1935 and at this time a laparotomy was performed under ether anesthesia. There was not a single adhesion involving the small intestine at any point, and only one apparently innocuous adhesion along the course of the transverse colon. The cecum was found to be large and redundant and was therefore fixed to the anterior abdominal wall with chromic catgut. Amniotic fluid was inserted into the peritoneal cavity. Ten days after operation the patient had a similar attack of abdominal pain, vomiting, distention, and obstipation with evidence of greatly increased peristalsis. This occurred at a time just after freedom from mechanical obstruction had been verified by direct observation. A psychiatric consultation was requested.

In September 1936 a similar obstructive attack followed the swallowing of three pins and a needle. The former were recovered in the stools but the latter was not found. The following month it was again found necessary to hospitalize the patient because of abdominal pain, nausea, vomiting, and abdominal distention accompanied by high pitched peristalsis. X-ray examination at this time revealed a markedly dilated colon with some spasm in the ascending portion.

In 1940 a right sacroiliac fusion was performed for the relief of low back pain. Obstipation, cramp-like abdominal pain, and distention necessitated hospitalization again in March 1941 and a barium enema revealed colonic atony and a long redundant sigmoid. No evidence of organic obstruction was found. The attack subsided spontaneously.

From January to December of 1944 repeated attacks of pain, vomiting, distention, and obstipation required hospitalization. Gastric suction and sedation were required to help the patient through each attack. No operation was performed. These symptoms reappeared again in March, 1946 and the patient again entered the hospital. At this time barium was introduced into the duodenum through an in-

dwelling Rehfuss tube. From this region barium passed through the jejunum and proximal ileum at a normal rate outlining essentially normal small bowel. However, at approximately the region of the mid ileum there was a retardation of flow and films taken over a period of 6 1/2 hours showed only slow progression of the barium to the cecal region. At the end of this time, considerable barium remained in the terminal ileum, but no cause was demonstrated for its exceedingly slow progress. An exploratory laparotomy was performed and careful examination of the entire intestinal tract was made. A few minor adhesions were found in the region of the hepatic flexure and the old gall bladder bed, and the cecum was found to be fixed to the anterior abdominal wall. No point of obstruction could be found and the remainder of the intestinal serosa was smooth and glistening. It was felt at this time that the previous attacks of intestinal obstruction had been due to some type of autonomic imbalance.

In October 1946 readmission was again found necessary and this time due to the patient's refractoriness. Intestinal suction was impossible and the patient went home unrelieved. Three weeks later the patient was admitted in the midst of a characteristic attack of cramp-like abdominal pain, vomiting, distention, and obstipation. It was decided to institute a study of the autonomic control of this patient's intestinal tract. Accordingly a differential spinal block was administered.

When this was done there was vasodilation in the lower, but not the upper extremity and a loss of pinprick sensation to the eighth thoracic segment. Sweating ceased on the lower extremities. There was no loss of motor power, touch or position sense. Prior to the onset of the block, the abdominal girth was 29.5 inches, distention and resistance were considerable. Coincident with the onset of the sympathetic block, intestinal activity became more active (borborygmi) and large amounts of flatus were passed. Within 40 minutes the abdominal girth was reduced from 29.5 to 26.5 inches and the abdomen became strikingly softer and flatter. The patient, an unusually competent observer, was impressed and elated with the results. She continued to pass gas throughout that afternoon and evening at the end of which time the abdominal girth was 25.5 inches. The patient stated that she felt perfectly normal at that time and it was her opinion that that attack had been abruptly and completely terminated.

Inasmuch as the 13 years from 1933 to 1946 had been filled with major attacks requiring hospitalization and minor episodes which the patient weathered at home, it was thought advisable to attempt more definitive therapy in order to prevent the progress of the downhill course this patient had traveled in the recent 16 months. Accordingly a right transthoracic sympathectomy was performed in December 1946. Abdominal distention without nausea, pain or vomiting appeared in the 4th, 5th, 6th and 7th postoperative days. The nature of the distention postoperatively will be discussed later.

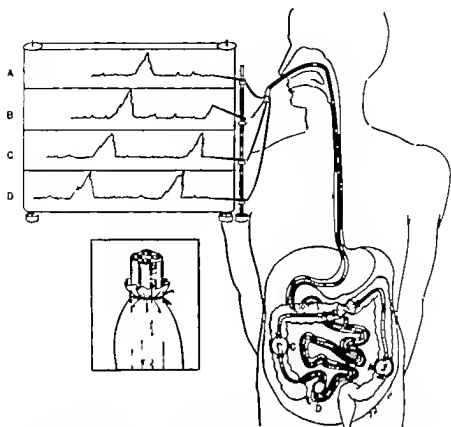


Fig. 12. Schematic presentation of how the four balloon intestinal tube works. Each balloon is connected to a separate recording pen by a channel isolated from the other balloons and pens. By correlating the balloons A, B, C and D with the records A, B, C and D it can be seen that the peristaltic wave has passed balloons D and C and is now at B and has not yet arrived at balloon A in the descending colon.

At the present writing 9 months after operation, the patient has not required hospitalization and has gained 11 pounds in weight. She is carrying a normal work load satisfactorily and has had but two episodes of abdominal distress. One of these was accompanied by mild distention; neither attack lasted longer than 12 hours. A more complete evaluation will be made at a later date.

CASE 2. The second patient was a 24 year old registered nurse who entered the hospital on December 26, 1945, with the chief complaint of increasingly severe abdominal pain. In 1944 an appendectomy had been performed for right lower quadrant pain, accompanied by nausea and vomiting. From then on she suffered from the severe, cramp-like abdominal pain that culminated in her present admission. This pain was accompanied by vomiting during her more recent attacks. Periods of repeated attacks were accompanied by obstipation lasting up

to 4 days. Distention, although frequently present, was not a prominent feature of the clinical picture. Rather the attacks of excruciating pain were accompanied by a rigid boardlike abdomen and unless one was acquainted with her previous history the diagnosis of a ruptured viscus suggested itself. Three exploratory laparotomies had been performed for lysis of adhesions, and at the last operation a resection of an adherent loop of bowel was performed. Although the patient left the hospital slightly more comfortable after each of these procedures, she was never free of pain and had frequent severe attacks while out of the hospital.

Röntgenographic examination of the intestinal tract during attacks revealed the presence of exceedingly swift peristaltic rushes starting in the upper jejunum and carrying to the area of terminal ileum. No distinct point of obstruction could be identified, however.

Full spinal anesthesia using 120 milligrams in 4 cubic centimeters of cerebrospinal fluid brought about complete and immediate abolition of the typical attack on three separate occasions. The boardlike abdomen naturally disappeared under the in-

After two moderate bouts of intestinal distention with abdominal pain that was completely left sided in location, left thoracolumbar sympathectomy was performed on November 2, 1947. Since that time the patient has had no further distention and has had no abdominal symptomatology.

fluence of the full spinal anesthesia since the somatic motor neurons were blocked.

Following the onset of a typical attack, a differential spinal block was administered. Shortly after the rise in skin temperature and fall in blood pressure, the abdominal pain began to diminish and within 10 minutes was completely gone (Fig. 1b). The loss of appreciation of pinprick sensation extended to the second thoracic segment but there was no loss of touch, vibratory sense, position sense, or motor power. Despite the absence of the loss of motor power the abdominal wall lost its rigidity coincident with the disappearance of the pain. The interpretation of this patient's disturbance of intestinal motility will be made below after it has been demonstrated that visceral afferent fibers are unaffected by the introduction of that concentration of procaine used in a differential spinal block.

Following a right sided lumbodorsal sympathectomy this patient has had one episode of mild abdominal discomfort. At this writing she is free of symptoms and is carrying a normal nursing work load satisfactorily.

CASE 3 The third patient is a 32 year old unmarried nurse and is perhaps the most complex and interesting patient in the group albeit the least satisfactory from a long range therapeutic point of view. She will be presented only briefly here in relation to the effect of two differential spinal blocks performed during two of her many bouts of intestinal obstruction.

An appendectomy had been performed in 1933, and three laparotomies for lysis of adhesions had been performed before she was first seen in this hospital in 1941. From then until March 1946 the patient was admitted nine times with the signs and symptoms of acute and chronic intestinal obstruction and had three further laparotomies for lysis of adhesions and various sidetracking procedures including a resection of densely adherent coils of small bowel.

When seen in March 1946 she was in the midst of one of her characteristic attacks of abdominal distention and tympanites, cramp-like abdominal pain, vomiting and obstipation of 3 days duration. For the ensuing 3 weeks she was maintained on the Miller Abbot tube, intravenous feedings and minimal oral intake. During that period she had had only one spontaneous bowel movement. Just prior to the administration of the differential spinal block her abdomen was markedly distended and resistant and high pitched peristalsis was present.

When the differential spinal block was performed she sustained a loss of the appreciation of pinprick to the seventh thoracic segment, but had no loss of motor power, position sense or touch. The appearance of the abdomen changed radically under the influence of the block. The circumference fell from 31 to 26 1/2 inches and the resistance was greatly diminished. In general, the abdomen became distinctly softer and flatter in a period of 30 minutes. This was accompanied by a small bowel movement

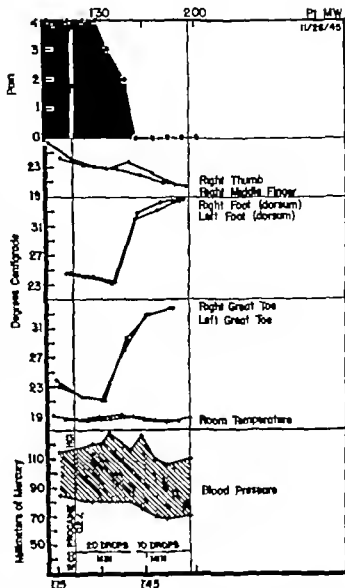


Fig. 1b. Case 3. The top portion shaded in black represents the amount of pain the patient was experiencing from none at all to excruciating. The next three brackets represent the skin temperature of the upper and lower extremities, as indicated, in degrees centigrade. The lowest bracket shows the blood pressure in millimeters of mercury and the rate at which the intraspinal drip was administered in drops per minute (20 drops per c.c.) after the initial dose of 12 c.c. of the 0.2 per cent solution of procaine hydrochloride.

and the passage of large amounts of flatus. The intestinal sounds, followed from the beginning of the procedure likewise suggested a significant increase in co-ordinated intestinal activity under the influence of the block. It was interesting to hear the sounds change from the high pitched 'ping' to a more normal pitch as the distention disappeared. By 24 hours after the block the patient had had five bowel movements and had passed a great deal of flatus the abdomen remaining soft and flat. At the end of 48 hours nothing more was being passed per rectum and abdominal distention was becoming apparent.



Fig. Case 5. Roentgenogram showing this patient's toxic, redundant colon, 8 hours after the insertion of barium.

The patient was seen on one subsequent occasion in the Emergency Ward with more or less the same picture. It was apparent, however, at that time that she was heavily under the influence of a narcotic to which she had become addicted during the course of her many illnesses. A differential spinal block was promptly administered but had only a slight effect in relieving the distention and in promoting the passage of flatus. The patient was transferred to the Psychiatric Ward for badly needed attention but signed out against advice 48 hours later when it became clear that medication was to be withheld.

Subsequent transthoracic sympathectomy was carried out at another institution by Dr. Smithwick who demonstrated regrowth of splanchnic fibers. She is currently free of abdominal distention and although abdominal pain is still mentioned she now complains mostly of joint pain.

CASE 4. The fourth patient was a 38 year old housewife who entered the Massachusetts General Hospital for the first time on October 15, 1946 with the chief complaint of abdominal pain, distention and obstipation. She had her first exploratory laparotomy performed in 1936, in an attempt to determine the cause of her sterility. At that time a fixation of the round ligaments, appendectomy and myomectomy were performed. In May, 1937 a right tubal pregnancy was removed and the uterus suspended. Moderate intraperitoneal hemorrhage was

noticed at the time. The patient gave birth to a normal female infant in May, 1938. A second ectopic pregnancy was removed in 1941, and in March, 1942 after a period of severe abdominal pain, a left oophorectomy and hysterectomy were performed. In November, 1942 the right ovary was removed after additional abdominal pain. In the immediate postoperative period there was evidence of urinary extravasation and the abdomen had to be reopened for a ureteral repair.

In December, 1944 she was hospitalized and studied because of attacks of distention and what was described as subacute small bowel obstruction. At that time the patient noted that anything but a light meal was followed by attacks of distention.

In the first week of September, 1946, 6 weeks prior to her first surgical admission to the Massachusetts General Hospital she began having severe, cramp-like lower abdominal pain and intermittent periods of abdominal distention. This usually followed the ingestion of food. Between the time of onset and admission she had lost 23 pounds, because of abstinence from food. She had moved her bowels only once in the 2 weeks prior to entry and the passage of gas gave her great discomfort.

The periods of distention were observed while she was in the hospital and a correlation between them and the ingestion of any sizable amount of food was established.

All who saw the patient agreed that her symptoms had to be evaluated against a highly neurotic background and this impression was confirmed by numerous bizarre symptoms such as radiation of the lower abdominal pain to the shoulder and down the leg.

A differential spinal block was performed on October 25, 1946 with the four balloon intersubcutaneous in place. It was determined at the time that the periods of severe pain were, in general, accompanied by peristaltic waves of increased height. This was helpful in establishing the genuine nature of the pain. Other than that, little of interest was obtained from the tracings. Following the block the patient began to pass flatus and continued to do so. The following morning the abdomen was observed to be scaphoid. It had not been flat since admission. The distention, pain and high pitched peristalsis remained absent for a day, and the patient felt that her intestinal tract was acting normally for the first time in 7 weeks. On the third day after the block the patient reverted to her former status.

Opinion as to whether to do an exploratory laparotomy or a sympathectomy was evenly divided at that time. Three factors spoke for sympathectomy: (a) the decided, albeit temporary, change in the clinical picture which followed the differential spinal block; (b) the recurrent nature of peritoneal adhesions with the tendency for the patient to enter "that dreadful downhill road on which the surgeon cuts the adhesions and the patient reforms them until either the surgeon tires or the patient dies";

Lord Moyalman.

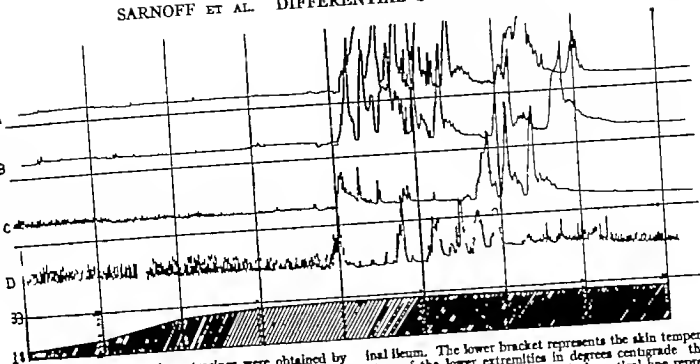


Fig. 3. Case 5. The above tracings were obtained by means of a four balloon intestinal tube. Tracing A is from the balloon in the descending colon. Tracing B is from the balloon in transverse colon. Tracing C is from the balloon in ascending colon. Tracing D is from the balloon in terminal ileum.

The lower bracket represents the skin temperature of the lower extremities in degrees centigrade the range is from 28 to 33 degrees. Each vertical line represents a 5 minute period. The differential spinal block was begun 20 minutes prior to the beginning of tracing.

(c) the patient's life was in no immediate danger from the obstruction since it was intermittent and the vomiting was limited. Since the patient's symptoms were more pronounced on the left a left sided sym plectomy was performed on November 1, 1946.

The patient began to eat and have normal bowel movements on the second postoperative day. With the exception of one bout of distention on the tenth postoperative day the preoperative symptoms of distention, pain, high pitched peristalsis, and constipation with painful defecation were absent in the immediate postoperative period. A troublesome intercostal neuritis subsided only slowly but finally disappeared.

At this writing 11 months after operation it is difficult to be certain of what has been accomplished by symplectomy. The patient has had two episodes of right sided abdominal pain with a questionable distention. The background of a deeply rooted hypochondriasis makes the certain evaluation of her status impossible. However following the cessation of the medication that was necessary for the intercostal neuritis she began to gain weight and is now 11 pounds over her admission weight. Hospitalization has not been necessary, and she is carrying a normal work load satisfactorily.

CASE 5. This 45 year old housewife was admitted to the Massachusetts General Hospital on September 26, 1946 with the chief complaint of increasingly severe constipation. The past history revealed that she had been somewhat constipated since early childhood but 13 years ago at which time radium sterilization was carried out she noted that her symptoms had become much more severe. Four years ago after x ray examination a diagnosis of enlarged

atonic colon was made at another institution and diet therapy was instituted. She was told to stop taking enemas and cathartics, and during that period would go as long as 7 days without having a bowel movement before finally resorting to colonic irrigation.

The patient was seen to be a highly nervous easily upset individual who seemed to magnify minor difficulties into major obstacles. X ray examination revealed a redundant, atonic colon that did not empty for at least 8 hours after the insertion of the barium (Fig. 2).

During the course of the clinical evaluation of this patient a condition a differential spinal block was done with the four balloon intestinal tube in place.

As the block was pushed upward sweating ceased, vasodilatation occurred in the lower extremities and there was a loss of the appreciation of pinprick to the sixth thoracic segment. There was no loss of touch position sense vibratory sense or motor power. It can be seen that as the vasodilatation became maximal in the lower extremities the colon previously quiescent became extremely active. The height of the contractions was twice to three times that of any previous waves recorded in this patient. (Continuous recordings of 2 hours duration had previously been obtained.) This activity lasted until the subarachnoid drip was discontinued and the skin temperature began to fall. The sequence of contractions from ileum to ascending to transverse to descending colon leaves little doubt that this activity represents true peristalsis and not simply segmental or ring like contractions (Fig. 3).

That this burst of colonic activity was spontaneous or a mass peristaltic rush and simply coincident

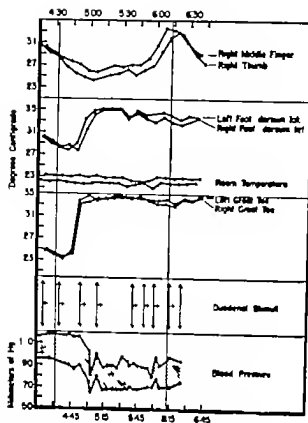


Fig. 4. Case 6. The above figure presents the data obtained on skin temperatures in degrees centigrade. The time at which identical duodenal stimuli were applied are shown by the arrows, the plus marks indicating an undiminished response. The arterial pressure in millimeters of mercury is also shown. The differential spinal block was started at the first vertical line discontinued at the second. At 6:30 p.m. there was an abolition of vasoconstriction in the upper as well as the lower extremity, sudomotor block of the entire body, and loss of pinprick sensation to the angle of the jaw. At no time was there any change in the sensory threshold to balloon distention of the duodenum. There was no loss of touch, position sense, or motor power.

dental with the block rather than a result of it must be considered. However two facts militate against such a conclusion: (a) the period of peristaltic rushes was 15 minutes, which is longer than one would ordinarily expect it to be on the basis of available evidence; (b) the time sequence in which the various events took place make it quite improbable that the colonic activity was an independent phenomenon.

The patient was discharged from the hospital on a low roughage diet and has taken a distinct turn for the better, having more or less regular daily bowel movements at the present time. The periods of constipation that she has experienced since discharge have been related in a very clear manner to periods of either overwork, mental tension, or as has frequently been the case, both.

CASE 6. This 36 year old patient entered the hospital on January 25, 1946 for the evaluation of chronic, epigastric pain concerning which a diagnosis had not previously been made. In the course of the investigation a differential spinal block was performed with an infusing balloon in the fourth portion of the duodenum. Prior to the onset of the block the sensory threshold was determined in terms of the number of cubic centimeters of air that it was necessary to inject in a given time in order to elevate the balloon pressure to a given level. The differential spinal block was instituted and carried upward until there was a vasomotor and sudomotor block in the upper as well as the lower extremities and there was a loss of the appreciation of pinprick up to the angle of the jaw. There was no loss of touch, position sense, or motor power. Throughout the procedure repeated determinations of the sensory threshold to duodenal distention were carried out (Fig. 4). At no time was there any change in the threshold of the sensation of duodenal distention.

This case is presented in order to demonstrate the fact that the fibers carrying impulses which are concerned with the sensation of intestinal distention are not influenced by that concentration of procaine capable of blocking sympathetic efferent and proprioceptive fibers.

CASE 7. This 60 year old retired physician was admitted to the hospital for the study of intractable rectal pain of 20 years duration. During the preceding 20 year period numerous rectal and bowel operations had been performed including hemorrhoidectomy, excision of anorectal scar tissue, resection of sigmoid intussusception, and sigmoid colectomy. In the course of the investigation of the rectal pain a differential spinal block was performed. Block of vasomotor and sudomotor fibers was obtained in the upper as well as the lower extremities, and there was a loss of the appreciation of pinprick to the second thoracic segment. A balloon had been inserted 9 inches up into the rectum and at no time was there any diminution in the appreciation of rectal distention. There was no loss of position sense, touch, or motor power.

The results indicate that the fibers carrying the impulses concerned with the appreciation of intestinal distention are not blocked by that concentration of procaine which is capable of blocking sympathetic efferent fibers in the subarachnoid space.

Two other sets of data, not included here, confirm the above impression that visceral afferent fibers carrying impulses concerned with intestinal distention are relatively large heavily myelinated fibers.

RESULTS

The results may be summarized as follows

1 *Following the block of visceromotor fibers* to the intestinal tract by a differential spinal block definite evidence of increased propulsive and co-ordinated bowel activity was obtained in 3 patients Cases 1 3 and 5 In Case 5, this consisted of the increased height and frequency of contractions as determined by the 4 balloon intestinal tube. In Cases 1 and 3, the evidence consisted of a dramatic change in the appearance of the abdomen, and the passage of flatus and feces. In one of these patients, Case 3 a subsequent differential spinal block was ineffective while the patient was under the influence of a narcotic. Of the remaining patients studied for bowel activity the first, Case 2 had a disappearance of severe pain while under the influence of that concentration of procaine in her subarachnoid space which was incapable of interrupting the sensation of pain from distention Presumably therefore her relief was due to an alteration in or better co-ordination of bowel activity The last remaining patient Case 4 had no change in the activity of the intestine from which the intestinal balloon was recording but had a decided change in the appearance of her abdomen following the block.

2 *That visceral afferent fibers* (subserving the sensation of distention) are not blocked by that concentration of procaine hydrochloride capable of blocking sympathetic efferents, was demonstrated by Cases 6 and 7 Two additional patients, studied with the conventional type of spinal block, confirmed these data.

DISCUSSION

Previous investigations with differential spinal block (18 19 20 21) have been aimed in part at clarifying the morphology of the fiber size of the nerve roots in the subarachnoid space The evidence cited in the foregoing cases would indicate that visceromotor fibers are of about the same size and degree of myelination as other sympathetic efferents. This is in accord with Gaskell's early observations that preganglionic sympathetic efferents are all of about the same size (10) The visceral afferents on the other hand would seem to be larger more heavily myelinated fibers,

since impulses carried over them were not blocked by that concentration found to be capable of causing an efferent block It is interesting in this connection that Sheehan and Edgeworth demonstrated the presence of myelinated afferent fibers in the mesentery of the human This is of considerable interest in the study of the patients here presented since it suggests that the relief obtained from the differential spinal block was not due to the block of afferent impulses concerned with the sensation of distention The rational presumption would then be that it was rather due to the alteration of a disordered motor function, a correction of dyskinesia.

It is not the purpose of this report to present the merits of sympathectomy in this group of cases When the follow up period has been adequate a detailed report dealing with the whole symptom complex and etiology will be published by the gastrointestinal service of this clinic The above cases however indicate the ease with which intestinal dyskinesia can be confused with acute mechanical obstruction They likewise demonstrate the use of a sympathetic block in abolishing the obstructive attack and clearly demonstrate the participation of a neurogenic component

The diagnosis of neurogenic intestinal obstruction may be an exceedingly difficult one to make without the proof conferred by the results of some sort of sympathetic block. The chronicity of the complaint with a history of many minor as well as several major episodes is characteristic These patients were all diagnosed as being neurotic with varying degrees of hypochondriasis. All our patients but one were women and had undergone multiple laparotomies Under other conditions most of them would probably have had further abdominal exploration for lysis of adhesions One cannot help wondering whether some of the so called chronic adhesion formers who are subjected to multiple laparotomies would not benefit from an appraisal of the autonomic component Sometimes the 'point of obstruction' is not defined at laparotomy as precisely as might be desired and little is gained by the laparotomy other than the anesthesia to which the patient is subjected As often as not, this is spinal anesthesia

One may be called upon to use a differential spinal block in connection with this group of patients under two different sets of circumstances. The first is exemplified by Case 2 in which the visceral disorder was not life threatening and additional abdominal surgery was not considered at that time. The second type is exemplified by Case 1 in which the clinical picture was not sufficiently clear to rule out an acute organic mechanical obstruction. It would seem wisest under these circumstances to set the patient up for laparotomy with a continuous spinal needle in place and induce a full spinal anesthesia. A period of 60 to 90 minutes will suffice to bring about the passage of flatus and feces and a dramatic change in the appearance of the abdomen will occur if the obstruction has a significant neurogenic component. In retrospect the last laparotomy performed on the patient of Case 1 would almost certainly have been avoided if this course had been pursued.

It is important to omit the administration of morphine and atropine or scopolamine. For as Helm and Ingelfinger have pointed out these drugs inhibit the usual increase in bowel activity induced by spinal anesthesia, presumably by a direct effect on the bowel itself (12, 13). The fact that morphine can qualitatively alter the response of the bowel to a sympathetic block is of help in the interpretation of Case 3. At the time she was given the last differential spinal block the results of which were not impressive she was heavily under the influence of a narcotic although the exact drug was not determined. The patient was transferred from the Emergency Ward where the block was performed to the Psychiatric Ward where all medication was withheld and the intestinal distention gradually passed off.

It is interesting to speculate on the nature of the abdominal distention that occurred in Case 1 from the fourth to seventh postoperative days. It has long been known that in patients subjected to a preganglionic sympathectomy of the extremities for vasospastic disease, a period of autonomic activity occurs sometime in the first 10 days usually from the third to the seventh. This period carries with it a distinctly lowered skin temperature and

increased sweating of the denervated extremity. The nature of this postoperative postganglionic activity has recently been elucidated by Smithwick (25). Since the intestinal sympathectomy done in this patient was in part preganglionic it seems not unlikely that the observed intestinal quiescence from the fourth to the seventh postoperative days was due to activation of the decentralized postganglionic fibers just as is the vasospasm and sweating of the sympathectomized extremity. This intestinal phenomenon has been noted in patients sympathectomized for hypertension (24).

The untoward sequelae of a differential spinal block are much the same as those of the full spinal block. It is usual to observe a fall in blood pressure as the procaine ascends to the higher reaches of the subarachnoid space (19, 20, 21). This technique has been used in over one hundred patients for varying purposes related to the study of autonomic function especially hypertension. The fall in blood pressure has always been readily controlled by placing the patient in the head down position when it became advisable to do so. Nausea and vomiting may occur and cease soon after discontinuing the infusion. Spinal headache occurs as after any lumbar puncture. One patient had mild meningeal irritation for 2 days following a differential block. No other serious sequelae have occurred.

It is conceivable that the increase in bowel activity engendered by a spinal block in a patient with mechanical intestinal obstruction may result in a perforation. However the widespread use of spinal anesthesia for surgery on obstructed patients is evidence of the relative safety of this procedure.

A long enough period has not yet elapsed to allow of the critical evaluation of the merits of sympathectomy in these patients. It is hoped however that the procaine block of visceromotor fibers to the intestinal tract will provide a degree of prognostic accuracy for visceromotor disorders which the block of vasomotor fibers provides in vasospastic disease.

CONCLUSIONS

1. Visceromotor fibers to the intestinal tract are of about the same size and degree of mye-

lination as other sympathetic efferent fibers in so far as this similarity is indicated by their relative susceptibility to procaine hydrochloride.

2 Block of sympathetic efferent fibers to the intestinal tract was followed by a definite increase in propulsive bowel activity and co-ordination of transport in 3 of the 5 patients studied and a probable alteration in bowel activity in the remainder.

3 Visceral afferent fibers subserving the sensation of distention are relatively large myelinated axones in so far as this is indicated by their relative refractoriness to procaine hydrochloride. They are not blocked by that concentration capable of interrupting sympathetic efferents (vasomotor sudomotor and visceromotor) and fibers carrying the appreciation of pinprick.

4 Impulses traveling over autonomic nerves can contribute significantly to the production of a syndrome consisting of distention obstipation, tympanites, fecal vomiting and cramp-like abdominal pain which can be easily confused with acute, mechanical intestinal obstruction. This type of neurogenic obstruction may be sufficiently obscure to precipitate numerous abdominal interventions and the patient finally falls into that category labelled the multiple laparotomy syndrome.

5 The conventional type of full spinal block and a differential spinal block are of value in relieving this type of bowel obstruction and in helping to establish the diagnosis. The differential spinal block is more specific as an investigative tool inasmuch as the fibers carrying distention pain are not interrupted. The alteration of bowel activity is therefore presumably due to a block of visceromotor fibers. It has the added advantage of allowing the patient to use her abdominal musculature in expelling colon contents at the peak of intestinal activity.

6 Impulses arising in the autonomic nervous system may be important in colonic atony as seen in the adult since block of the visceral

efferents can greatly alter colon activity in such a patient.

7 It is of great importance to withhold medication when attempting to augment intestinal activity and transport by means of spinal anesthesia.

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THE BIOLOGICAL CHEMISTRY OF WOUND HEALING

I The Effect of dl Methionine on the Healing of Wounds in Protein Depleted Animals

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THE tissues are dynamic structures with metabolic and catabolic phases proceeding concomitantly. The processes of tissue synthesis and destruction are chemical in nature. Proteins, nucleotides, lipids, carbohydrates, crystalloids, oxygen water enzymes, catalysts and other factors probably take part in these as yet poorly understood reactions. Following the infliction of a wound in a normal organism the chemical processes involved in tissue synthesis are accelerated and rapid healing results. In protein-depleted subjects these processes apparently are impaired and healing is delayed.

Howes and his co-workers (14) studied the effect of complete starvation on the rate of fibroplasia in wounds of adult rats and concluded that complete starvation did not alter the healing curve. However in young rats they found that complete or partial starvation did appreciably retard the rate of fibroplasia, and thus prolonged the proliferative phase and final healing. Clark noted that a diet high in protein shortens the lag period in the repair of experimental wounds. Harvey and Howes (13) noted no change in the lag period in protein fed rats, but the velocity of fibroplasia and the proliferative phases were stimulated. Thompson, Ravdin, and Frank showed that the hypoproteinemic dog is incapable of normal fibroplasia. Koster and Shapiro (17) and Koster and Kasman (16) have shown that hypoproteinemia is a factor in the faulty healing of wounds that eventuate in disruption. Localio, Casale and Hinton (20) stated that the lag period and the period of final healing were delayed in protein-depleted rats. Localio, Chassin and Hinton (22) showed that deple-

tion of the tissue proteins was a factor in human wound disruption.

It is generally agreed that in animals and humans, protein depletion adversely affects the healing wound. Healing although delayed and abnormal in the protein-depleted subject, nonetheless does occur. There are many other factors that affect wound healing these are reviewed elsewhere (20, 21) and are not a part of this study.

It has been shown that the delayed healing of wounds in protein-depleted subjects can be corrected by the administration of high protein diets and hydrolysates (34). Madden (23, 24) and Rose (29, 30) have demonstrated that humans and animals can be maintained in positive nitrogen balance by the administration of synthetic amino acids as the sole source of nitrogen. Rose has accomplished this by the use of nine amino acids which are essential to rat growth. Although all of these amino acids are essential for the maintenance of nitrogen balance it has not been determined if all of them are vital for wound healing. It is unlikely that all of these amino acids take part in the healing of a wound for some of the acids are necessary for functions not directly related to wound healing. A deficiency of lysine may cause menstrual irregularities in the female and a deficiency of arginine in the male is followed by a low sperm count. These and other symptoms not directly related to wound healing are listed by Albanese as due to deficiency of specific essential amino acids.

Hammitt (11, 12) in experiments done on the growth of the carrot root, has shown that there is an increase in the number of the root cells if the sulfhydryl (SH) group was added to the cultures. Baker believes that glutathione, a sulfhydryl compound is a growth stimulating substance. Croft and Peters (9, 10) and

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TABLE I.—EXPERIMENTAL MATERIAL

Days postoperative	Number of animals			Total animals
	Normal	Hypo-proteinemic	Methionine	
1	5	0	5	10
2	5	6	7	18
3	5	6	8	19
4	5	7	7	19
5	5	7	7	19
6	5	7	6	8
7	5	6	7	8
8	5	10	7	
9	5	7	6	18
10	0	7	7	14
Not operated upon	30			30
Total	64	63	67	194

others (3, 6, 26) indicate that in rats and dogs dl methionine spares nitrogen however this has not been confirmed for man (8, 15). Because it contains the sulfhydryl radical because it spares nitrogen in animals and because it is an essential amino acid, methionine was chosen as the first amino acid to be tested.

MATERIAL

Young white adult male rats of pure Wistar strain purchased from a commercial breeder were used in the experiments. The first group of 65 animals were normal controls. The second group of 63 animals were depleted and rendered hypoproteinemic by means of diet. The third group of 67 animals were depleted exactly as group 2. After 5 weeks of depletion and during the course of wound healing these animals received dl methionine (Table I).

METHODS

The methods used for the determination of the tensile strength of the experimental wounds have previously been reported (18). Aseptic wounds exactly 3 centimeters in length were made to the right of the mid line in the upper abdomen of the animals. The wounds were closed with interrupted sutures of No. 36 Pilling stainless steel wire. Animals were sacrificed daily from 1 to 10 days and the tensile strength of the wounds determined by dis-

TABLE II.—PRESSURE NECESSARY TO CAUSE DISRUPTION OF ABDOMEN OF ANIMALS NOT OPERATED UPON (CONTROLS)

No. of animal	Pressure in mm. of mercury	N. of animal	Pressure in mm. of mercury
1	83	11	93
2	98	12	108
3	93	13	93
4	87	14	96
5	0	15	15
6	87	16	95
7	93	17	90
8	96	18	103
9	93	19	108
10	93	20	11

Total animals, 30; mean tensile strength, 97.7 millimeters standard error of the mean, 1.75 millimeters.

tending the peritoneal cavity with air and measuring the bursting pressure of the wound in millimeters of mercury.

The control group of animals were maintained on a basal ration of purina chow. The second and third groups of animals were placed on a diet consisting of 10 per cent carrot powder, 5 per cent crisco, 3 per cent agar, 1 per cent salt water was permitted *ad libitum*. Vitamins were not added to the diet. The diet contained 0.23 per cent nitrogen. Animals in group 2 were maintained on this diet for 5 weeks and then were operated upon. Animals were sacrificed daily heart blood was withdrawn for total protein determination and the tensile strength of the wound was determined.

Animals in group 3 were depleted and tested as were those in group 2. However each animal received 150 milligrams of dl methionine dissolved in sterile distilled water administered subcutaneously daily for a period of 10 days. The last injection of methionine was given 24 hours before the animal was sacrificed. Animals destroyed on the tenth day received methionine daily starting with the day of operation. Animals sacrificed on the fifth day received methionine 5 days before operation and 5 days after operation. Animals sacrificed on the second day received methionine for 8 days before operation and 2 days after operation etc. In this fashion all animals had received a

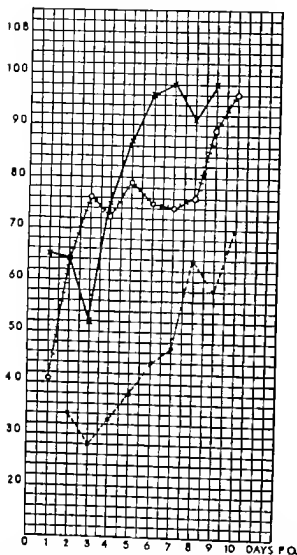


Fig. 1 Mean tensile strength of abdominal wounds in normal rats, —x— hypoproteinemic rats —+— and in methionine-treated hypoproteinemic rats o—+—o.

total of 1500 milligrams of methionine 24 hours before they were destroyed. Methionine was not administered to any animal until 5 weeks of dietary depletion had been completed.

RESULTS

Table II taken from previously published work (19) lists the maximum tensile strength in millimeters of mercury that can be applied to the abdominal cavity of normal unoperated control animals. The limiting factor is the tensile strength of the pelvic peritoneum. At a mean tensile strength of 97.7 millimeters of mercury disruption of the pelvic peritoneum

TABLE III.—DATA ON NORMAL WOUNDS

Days postoperative	No. of animals	Mean pressure necessary to cause disruption	Site of disruption
	5	65	All in wound
	5	64	All in wound
3	5	82	All in wound
4	5	75	All in wound
5	5	87	One in wound
6	5	96	None in wound
7	5	96	None in wound
8	5	98	None in wound
9	5	91	None in wound

occurs and higher mean pressures therefore cannot be applied to the wound. In animals operated upon where disruption has occurred in the pelvic peritoneum and not the wound, we have considered the wound healed. In some of the hypoproteinemic and di-methionine animals, the pelvic peritoneum disrupted at pressures appreciably less than 97.7 millimeters of mercury. In these wounds the tensile strength is that recorded, plus an unknown.

Table III from a previous publication (19), lists the mean tensile strengths of the wounds of normal operated animals. Tables IV and V list the weight loss, total proteins, and the mean tensile strengths respectively of wounds of the protein-depleted animals and of the protein-depleted animals receiving methionine.

Figure 1 is constructed by plotting the mean tensile strength of the wounds of normal animals, of the protein-depleted animals, and of the protein-depleted animals which received methionine. The comparative lag periods for the 3 groups are 3 days for the normal, 7 days for the protein-depleted and 1 day for the protein-depleted plus methionine. Table VI lists the percentage of wounds that could be disrupted in each of the three groups for the total period of 10 days of the experiment: normal 37 per cent, protein-depleted 73 per cent, methionine 36 per cent. The number of animals in each day in the three series is not strictly comparable. However the differences between the methionine-treated and untreated depleted animals is so great that the minor differences in the numbers of animals are not

TABLE IV—DATA ON INDIVIDUAL BURSTING PRESSURES ON EACH POSTOPERATIVE DAY FOR HYPOPROTEINEMIC RATS

Days postoperative	N. of animal	Bursting pressure mm. Hg	Mean bursting pressure	Site of disruption	Weight loss—grams	Total protein—grams %	Days postoperative	N. of animal	Bursting pressure mm. Hg	Mean bursting pressure	Site of disruption	Weight loss—grams	Total protein—grams %
	370	30	34.17 plus microns 7.43	Wound	60	4.00	6	366	4	44.30 plus microns .04	Wound	80	5.50
	371	35		Wound	50	4.30		373	58		Wound	60	4.40
	375	45		Wound	60	4.1		384	48		Wound	88	4.63
	378	55		Wound	70	5.00		385	40		Wound	78	4.86
	379	40		Wound	70	4.00		395	58		Wound	68	5.00
	380	30		Wound	60	3.00		397	78		Pelvis	84	3.70
3	172	8	27.83 plus microns 0.46	Wound	100	6.20	7	390	34	47.00 plus microns 17.46	Wound	64	5.20
	173	36		Wound	60	5.30		390	34		Wound	80	5.10
	174	32		Wound	64	6.00		308	58		Wound	104	5.38
	178	16		Wound	60	5.40		309	50		Wound	92	4.30
	372	40		Wound	60	4.00		315	72		Wound	66	5.10
	374	33		Wound	50	4.50		37	74		Wound	60	5.50
4	133	6	33.15 plus microns 26.07	Wound	60	3.70	8	330	50	63.8 plus microns 10.34	Wound	68	5.10
	144	34		Wound	60	3.10		341	64		Pelvis	72	5.00
	50	12		Wound	64	4.00		345	60		Wound	64	4.00
	151	12		Wound	70	4.1		348	64		Pelvis	72	4.00
	28	36		Wound	0	4.80		340	60		Pelvis	52	4.30
	103	14		Wound	6	6.20		350	86		Pelvis	72	5.80
5	112	28	38.0 plus microns 0.25	Wound	7	4.50	9	335	70	58.57 plus microns 4.84	Pelvis	80	4.20
	138	12		Wound	78	4.14		356	60		Pelvis	90	4.20
	13	44		Wound	60	4.0		357	55		Ileac	90	5.00
	214	20		Wound	68	5.14		360	60		Pelvis	70	4.30
	210	62		Wound	80	5.00		365	55		Wound	90	4.20
	120	18		Wound	70	4.00		366	60		Pelvis	90	4.60
6	225	56	44.20 plus microns .06	Wound	68	5.60	10	397	60	70.0 plus microns 7.07	Pelvis	90	5.10
	224	34		Wound	74	5.50		382	60		Pelvis	60	4.00
	137	43		Wound	96	5.53		383	60		Pelvis	90	4.30
	158	63		Wound	92	4.44		384	80		Pelvis	100	4.30
	103	24		Wound	70	5.00		401	65		Wound	50	5.10
	160	38		Wound	104	4.52		402	70		Ileac	90	4.40
	165	42		Wound	80	5.80		403	70		Pelvis	60	4.40
								404	65		Pelvis	70	4.20

significant. Statistical comparison of the normal and protein-depleted rats (Table VII) shows a significant difference in the tensile strength of the wounds between the normal and the protein-depleted animals, from the second to the ninth days, the wounds in the protein-depleted rats being significantly weaker than in the normal.

Similar statistical comparison between normal animals and methionine-treated depleted

animals indicates that the tensile strength of the methionine wounds is significantly less than the normals, on the first, sixth, seventh eighth and ninth days. However on the sixth seventh and ninth days no wounds disrupted. On the eighth day, two wounds disrupted. Since the tension required to produce a rupture of the pelvic peritoneum in the methionine animals is less than normal a fair comparison of wound strengths on these days is not possible.

TABLE V—DATA ON INDIVIDUAL BURSTING PRESSURES ON EACH POSTOPERATIVE DAY FOR METHIONINE-TREATED RATS

Days postoperative	No. of animal	Bursting pressure mm. Hg	Mean bursting pressure	Site of disruption	Weight loss—grams	Total protein—grams %	Days postoperative	No. of animal	Bursting pressure mm. Hg	Mean bursting pressure	Site of disruption	Weight loss—grams	Total protein—grams %
	304	55	41 plus saline 7.37	Wound		3.3	6	300	73	73 plus saline 6.38	Perine	60	5.65
	300	40		Wound	60	4.0		301	80		Perine	35	6.00
	301	45		Wound	70	5		303	73		Perine	80	5.80
	302	33		Wound	90	4.40		31	70		Perine	75	4.80
	304	30		Wound	70	4.40		312	65		Perine	70	4.00
	337	70	63.57 plus saline 30	Wound	100	4.8	7	313	85	74.80 plus saline 1.10	Perine	70	4.60
	338	80		Wound	80	3.6		305	75		Iliac	99	5
	350	73		Wound	65	4.5		308	55		Perine	105	4
	354	30		Wound	70	4.8		300	70		Iliac	90	3
	355	55		Wound	60	4		310	85		Perine	130	4.3
3	356	60	73.63 plus saline 6.82	Wound	50	4.3	8	320	80	76.17 plus saline 7.31	Iliac	80	4.1
	357	55		Wound	30	4		334	90		Perine	80	4.6
	310	70		Perine	85	4.80		333	65		Perine	80	4.4
	320	85		Wound	80	4.30		366	80		Perine	85	3.1
	321	75		Wound	80	4.60		368	78		Perine	103	4
4	323	70	72.30 plus saline 5.51	Wound	70	4.30	9	390	85	80.7 plus saline 4.48	Wound	72	4
	346	85		Perine	90	4.30		395	65		Wound	5	3
	347	65		Wound	80	4.30		397	85		Perine	100	4.6
	348	85		Wound	70	5.00		417	80		Perine	300	4
	349	70		Perine	60	5		418	80		Perine	80	4.4
5	366	70	72.30 plus saline 5.51	Perine	58	4.44	10	353	95	80.7 plus saline 4.48	Perine	90	4.3
	367	64		Wound	108	3.9		353	90		Iliac	80	4
	303	68		Perine	48	5.08		405	80		Perine	100	4.3
	303	58		Wound	70	3.00		407	100		Iliac	70	3
	304	55		Wound	85	3.65		109	90		Perine	70	4.4
5	333	90	78.71 plus saline 7.03	Perine	80	4.60		416	90	86.73 plus saline 14.08	Iliac	80	4.3
	339	78		Wound	80	4.50		360	80		Iliac	80	4
	180	85		Perine	100	5.80		36	85		Perine	90	4
	18	75		Perine	73	4.44		362	90		Iliac	90	4.4
	316	65		Perine	55	5.00		365	30		Iliac	80	4
	323	70		Iliac	90	5.00		366	105		Perine	30	4
	324	85		Perine	120	4.60		367	85		Iliac	80	5
	325	85		Wound	30	5.00		368	10		Iliac	70	4
	329	85		Iliac	100	4.30							

On the second fourth and fifth days the period of proliferation, there is no significant difference and on the third day the methionine-treated wounds had a significantly greater tensile strength.

Table IV lists the statistical comparison of the hypoproteinemic animals untreated and treated with methionine. The tensile strength

of the methionine-treated wounds is significantly greater on all days from the second to the tenth except the eighth. On this day the methionine treated wounds are not significantly stronger. However the *t* value noted was 2.54 which is only 0.41 from a critical level which would indicate a statistically significant difference.

TABLE VI.—INCIDENCE OF WOUND DISRUPTIONS AS PERCENTAGE OF TOTAL DISRUPTIONS

Normal				Methionine treated				Hypoproteinaemic			
Day #	No. rats	Wound disruptions	% disruptions	Day #	No. rats	Wound disruptions	% disruptions	Day #	No. rats	Wound disruptions	% disruptions
1	5	5	100	1	5	5	100	1	0	0	
2	5	5	100	2	5	5	100	2	6	6	100
3	5	5	100	3	5	5	100	3	6	6	100
4	5	5	100	4	5	5	100	4	7	7	100
5	5	1	20	5	5	5	100	5	7	7	100
6	5	0	0	6	5	5	100	6	7	7	100
7	5	0	0	7	5	5	100	7	7	7	100
8	5	0	0	8	5	5	100	8	7	7	100
9	5	0	0	9	5	5	100	9	7	7	100
10 to 60	(0)	(0)	0	10 to 60	(0)	(0)	0	10 to 60	(0)	(0)	0
Total	55	21	38.2	Total	55	21	38.2	Total	55	21	38.2

DISCUSSION

Wound healing in the protein-depleted rat proceeds with a prolonged lag period a prolonged proliferative period and delayed final healing. These results are in keeping with previous data (10) and coincide with numerous clinical observations (28).

The data further indicate that in protein-depleted rats the administration of one amino acid dl methionine can shift the curve of healing toward normal in spite of the fact that the animals are maintained on a depleting

diet, and they remain depleted as shown by the level of the total proteins. The lag period of methionine treated rats appears shorter than normal. The proliferative period does not follow the normal curve for there is little gain in tensile strength between the fourth and eighth days. However since many of these methionine wounds did not disrupt no fair estimate can be made of the wounds maximal tensile strength on these days. A comparison of methionine-treated and untreated animals shows a marked difference between lag pe-

TABLE VII.—STATISTICAL COMPARISON OF DAILY RESULTS OF TENSILE STRENGTH TESTS IN NORMAL AND IN HYPOPROTEINEMIC RATS

Days postoperative	Group	Mean bursting pressure	N of animal	S.D.	t	Degrees of freedom	t critical level ^a	Significance
1	N H	65.0	5	2.2				
2	N H	64.2 34.2	5	6.7	0.24	9	3.25	S.L.
3	N H	51.8 27.8	5	17.0	5.04	9	3.25	S.L.
4	N H	74.6 33.1	5	37.5	3.22	10	3.17	S.L.
5	N H	85.8 30.0	5	36.9	3.11	10	3.17	S.L.
6	N H	60.0 41.3	5	9.0	7.22	9	3.17	S.L.
7	N H	67.8 47.0	5	7.3	5.43	9	3.17	S.L.
8	N H	60.0 63.8	5	10.5	5.11	35	3.01	S.L.
9	N H	60.0 63.8	5	8.8	20.13	10	3.17	S.L.

^aNormal; H, hypoproteinaemic.

^bCritical level of t equals 2.01 at this level differences may be considered due to chance ± 100 times.

TABLE VIII.—STATISTICAL COMPARISON OF DATA ON NORMAL AND METHIONINE-TREATED RATS BY DAYS POSTOPERATIVELY

Days postoperative	Group	Mean bursting pressure	N. of animals	S D	t	Degrees of freedom	t at critical level ^a	Significance
	N	65	5					
	M	64	5	7.4	0.30	8	3.36	SL
	N	64	5					
	M	63.6	7	6.8	00	10	3.17	NIL
3	N	57.8	5					
	M	73.0	7	3.7	7.6	11	3.11	SG
4	N	74.6	5					
	M	72.3	7	3.5	68		3.17	NIL
5	N	80.8	5					
	M	78.7	7	3.6	80	10	3.17	NIL
6	N	96	5					
	M	73	7	9.0	4.17	10	3.17	SL
7	N	97.8	5					
	M	74.3	7	7.3	3.66	10	3.17	SL
8	N	97	5					
	M	76	7	5.3	3.60	9	3.25	SL
9	N	90.8	5					
	M	80	7	4.8	4.56	10	3.17	SL

N, normal; M, methionine-treated.

^aCritical level of t equals at this level differences may be considered due to chance 100 times.

riods, and it is only during the eighth day when the proliferative period of the untreated hypoproteinemc animals gets under way that these two groups of wound strengths begin to approach each other.

It is unlikely that one amino acid can supply the building stones for so complicated a chemical structure as the proteins of the fibroblasts healing the wound. A working hypothe-

sis must be sought to explain our results. The depleted animals in this study demonstrate delayed wound healing yet the wound did heal eventually in spite of the fact that postoperatively the animals were maintained on a protein-deficient diet. The protein building stones for healing were not administered to these animals, and hence they must obviously have originated from within the animal or

TABLE IX.—STATISTICAL ANALYSIS COMPARING HYPOPROTEINEMIC RATS WITH METHIONINE TREATED RATS BY DAYS POSTOPERATIVELY

Days postoperative	Groups compared	Mean bursting pressure	No. of animals	S D	t	Degrees of freedom	Critical level ^a	Significance
	H	34.17	6					
	M	52.0	7	7.9	5.3	11	3.11	SG
3	H	57.8	6					
	M	75.6	8	9.1	10.14	12	3.06	SG
4	H	33	7					
	M	72.3	7	27.3	3.40	12	3.06	SG
5	H	28	7					
	M	78.7	7	10.3	4.79	12	3.06	SG
6	H	44.3	7					
	M	73.0	6	6.4	5.7	11	3.11	SG
7	H	47	6					
	M	74.3	7	7.5	3.3		3	SG
8	H	63.8	7					
	M	70	7	10.3	34	5	05	N S G
9	H	58.6	7					
	M	80	6	4.8	10.85	11	3.11	SG
10	H	70	7					
	M	90.7	7	7.14	7.8	12	3.06	SG

H, hypoproteinemc; M, methionine-treated.

^aCritical level equals .05; at this level differences may be considered due to chance 100 times.

ganism. Preoperatively the stores of protein in the liver (r), and tissues were largely depleted hence we may assume that Nature in her desire to heal the wound has called upon the proteins of other cells for material. Mason (25) has stated that 'the urge to heal is equal to the urge to live. Nature will surmount all obstacles to close a wound'. Morgan in 1906 (27) showed that a starved salamander could regenerate an amputated limb as rapidly as a well fed animal. Regeneration occurs at the expense of other cells of the organism and the starved animal suffers atrophy of all its organs.

How can we account for the results obtained following the administration of dl methionine? Dl methionine must supply to the wound some factor which is not readily available or not available in sufficient quantities in the materials which the organism is able to supply to the healing wound. Dl methionine is the only essential amino acid containing the sulfydryl radical. If we reason that the sulfydryl (SH) radical is the chemical group that the depleted organism cannot supply to the healing wound in sufficient quantities and that without it the lag period of wound healing is delayed then we must search for a local wound function for the sulfydryl radical.

Barron and Singer have shown that there exists in a protein molecule certain bonds and groups in the side chain without whose integrity enzyme activity does not exist. Of these groups the electronegative sulfydryl (SH) group has been shown to be of much importance. They have shown that many of the reactions of the metabolic cycle are catalyzed by SH enzymes. Further that chemical blocking of the SH group of these enzymes with alkylating agents iodoacetamide mercaptide-forming agents, and organic arsenicals causes inhibition of enzymatic activity. The addition of excess SH groups in the form of glutathione dispels the inhibition and enzyme activity proceeds. Stevenson and White in an experiment in rat growth showed that the administration of iodoacetic acid to the intact animal interfered with growth. They believe this to be due to the inhibition of SH enzymes. The addition of l-cystine l-homocystine and dl-methionine all of which supply SH groups permit growth to proceed unhindered. There-

fore since chemically many of the metabolic enzymes can be inactivated by blocking of the SH groups with suitable compounds, and since rat growth can be arrested similarly and since wound healing and growth are closely allied processes we offer the following as a working hypothesis: the protein depleted animal, although able to obtain building stones for healing from sources within the body cannot obtain a sufficient number of sulfydryl (SH) groups from these sources. Dl methionine supplies these SH groups to the depleted animal and wound healing can proceed in a more nearly normal fashion. Further the SH enzymes appear to exert their most important function during the early stages of healing. Without this enzyme activity the lag period of healing is prolonged with it is shortened.

Experiments are now in progress to test the effect of other amino acids and of SH groups of other compounds on wound healing. The effect of dl methionine in the healing of wounds in the depleted human is also being studied.

CONCLUSIONS

1. Protein depletion in rats causes a prolonged lag period, a slowed proliferative period, and a delay of final healing.
2. Parenteral administration of dl methionine to protein-depleted rats shifts the curve of wound healing toward normal. The lag period is decreased, final healing is accelerated in spite of continued protein depletion.
3. A hypothesis is outlined indicating that the sulfydryl (SH) radical is deficient and not readily available to the wound of the protein deficient rat, and deficient SH enzyme activity may be one of the reasons for delayed healing.

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TUMORS OF THE TESTICLE

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THE diverse views expressed by various authors in attempting to classify testicular tumors have not made the discussion of this subject easy. A study of the literature indicates that various investigators are using different terms for the description of identical lesions and on the other hand, identical terms are being used for the description of different types of tumors.

The inadequacy of some of the heretofore advanced classifications is an undisputed fact. Pathologists and clinicians alike have applied a variety of descriptive terms to various types of testicular tumors and the detection of some unusual cell elements in certain neoplasms has often induced an investigator to complicate the already existent classification by the introduction of new subclassifications. This fact has resulted in the creation of cumbersome and at times confusing nomenclatures.

However it appears that recent investigations may have contributed materially to clarify our conception of the clinical and histopathological aspects of the disease. During the war it was possible to study a large number of patients with testicular tumors at various United States Army Hospitals and an even larger number of specimens at the Army Institute of Pathology.

Friedman and Moore, who had the opportunity to study 922 testicular neoplasms at the Army Institute of Pathology, have advocated a simplified classification which if found feasible would contribute greatly in establishing a common understanding among pathologists and urologists. They arrived at the conclusion that only 4 basic structural patterns were encountered in the majority of all tumors of the testicle. These cell patterns were described as seminoma, embryonal carcinoma, choriocarcinoma and teratoma

which may occur either alone or in combination. It was found that 96 per cent of the 922 cases fell into one of these categories. 3 per cent were considered too rare to be classifiable and 1 per cent consisted of interstitial cell tumors. In accordance with these statements the following implied classification was suggested: (1) seminoma, (2) embryonal carcinoma, (2a) choriocarcinoma, (3) adult teratoma, (4) teratocarcinoma or teratosarcoma.

PATHOLOGY

In adopting this classification we grouped our cases according to the following criteria:

Seminomas are monocellular tumors which consist of rounded polyhedral cells. Clear cytoplasm is the rule but variants with dark staining cytoplasm may occur. The hyperchromatic and irregular nuclei are usually centrally located and their chromatin is evenly distributed. Seminomas grow in solid sheets although a pseudoglandular appearance may be simulated as a result of separation of tumor masses by trabeculation of connective tissue. Lymphoid stroma may be absent or present in various amounts within the tumor bed (Fig. 1).

Embryonal carcinomas are tumors composed of embryonal type cuboidal or columnar cells which are larger than those of seminomas. The nuclei are large, their location within the cell varies and their chromatin is distributed in irregular masses. The differentiated part of the tumor is glandular in character often assuming papillary formation; however the undifferentiated areas are found to grow in solid sheets. In many cases embryonal carcinoma is associated with seminomatous tissue. Both cell types may then be found growing apart or closely intermingled. It is commonly observed that embryonal carcinoma invades seminoma tissue aggressively while it is found that seminoma respects tissue planes as it enlarges. Also choriocarcinoma ele

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Fig. 1. Seminoma.

AGE

The average age in our series of 202 patients was 33 years. However it was found that patients with seminoma belonged to an older age group (38.9 years, average) than those with embryonal carcinoma or terato-



Fig. 2. Embryonal carcinoma.

carcinoma (29.9 years, average). Over two-thirds (67.9%) of our patients were between 20 and 40 years of age. It was also noted that testicular tumors in patients under 20 years of age were more commonly encountered in cases of embryonal tumors (10%) while they



Fig. 3. Chorioepithelioma.



Fig. 4. Teratocarcinoma.

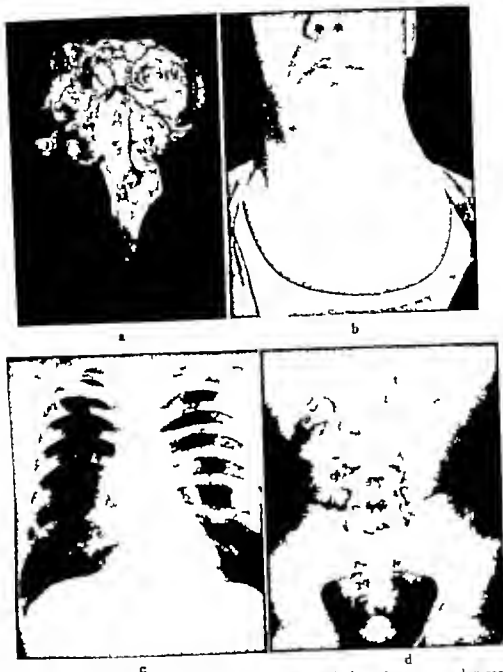


Fig 5 a, Small teratocarcinoma within normal testicular substance, causing carcinoma. b Large left supraclavicular metastatic lymph node. c, Moderately extensive multiple lung metastases and mediastinal involvement. d, Lateral displacement of left ureter due to pre-aortic metastases.

somewhat similar case in which the thyroid was the site of the primary lesion. In 1 instance we even found that painless tumefaction in both testicles was the first manifestation of an acute leukemia. Metastatic tumor growth in the testicle has lately been detected more often following the introduction of castration for the treatment of prostatic cancer.

Exploratory operation and not watchful waiting is the procedure of choice if the diag-

nosis is in doubt. In no cases should biopsy or needle puncture be resorted to as a means of establishing the diagnosis, because such a procedure would destroy the continuity of the capsule and facilitate dissemination of tumor cells.

More serious diagnostic difficulties are encountered at times, if the tumor arises in an undescended testicle. Particularly in a patient with an intra-abdominal testicle the neoplasm may assume considerable size be-

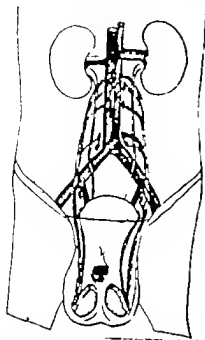


Fig. 6 Schematic drawing showing that lymphatics of the testis drain to abdominal-aortic and external iliac lymph nodes.

fore it produces symptoms. Pain in the lower abdomen and groin represent the usual manifestations but there are certain cases in which the primary tumor remains symptomless and the first and only evidence of the disease is produced by the development of distant metastases. Under these conditions, it is often difficult to recognize the nature of the disease. In any case malignant degeneration of an undescended testicle should be included in the differential diagnosis of certain cases of metastatic carcinoma of unknown primary origin especially when metastases are found in the retroperitoneal space lungs or left supraclavicular region (Fig 5 a b c d). A positive Aschheim Zondek test may be of value in the establishment of the diagnosis in certain cases however in others an intra-abdominal testicle cannot be definitely identified as the site of the primary tumor before postmortem examination.

METASTASIS

Metastatic spread of the disease occurs almost invariably by way of the lymphatics (Fig 6). Rouvière has demonstrated that the lymph trunks of the testicle ascend along



Fig. 7 Direct extension of testicular tumor into scrotum.

the blood vessels of the spermatic cord. At the crossing point of spermatic vessels and ureter the lymph vessels become separated from the internal spermatic artery and empty into the abdomino-aortic nodes. From there further dissemination may take place by way of the thoracic duct with potential involvement of mediastinum lungs, supraclavicular nodes etc. In addition a connection of testicular lymphatics and external iliac nodes has been described however it has been pointed out by Rouvière and others that these lymph vessels are not always present. Since there exists no connection between testicular lymphatics and inguinal nodes, it must be concluded that metastatic involvement of these nodes can occur only as the result of direct extension of the primary tumor into scrotal tissues (Fig 7).

When searching for possible metastases, the general pattern of metastatic dissemination must be kept in mind. While metastatic involvement of superficial lymph-bearing areas is readily detected and while metastases to lungs or mediastinum are quite reliably demonstrated by x ray examination some difficulty may be encountered in recognizing possible retroperitoneal metastases. Excretory urography which in certain cases must be supplemented by retrograde pyelography is often essential accurately to complete the diagnostic procedure since lateral displace-

TABLE III.—SITE OF METASTASES IN 117 PATIENTS

	Semi-noma 47 patients	Embryonal carcinoma 50 patients	Teratocarcinoma 4 patients	Miscellaneous 6 patients	Total 117 patients
Paraortic nodes	56	30	0	2	87
Lungs	1	31	0	6	38
Gonads and spermatic cord	15	8	1	3	27
Left supraclavicular nodes		0	2		2
Mediastinum		9			9
Liver	2	13			15
Iliac fossa	0	4			4
Bones	1	3			4
General carcinomatosis	0	10	7	1	18

ment of the ureter may indicate the presence of pre-aortic node involvement where palpation fails (Cahill)

Metastases were demonstrable in 117 or 57.9 per cent of our 202 patients. One hundred and eight of them had metastases at the time of admission and 9 developed metastatic lesions subsequently. The incidence of metastases was highest in the group of embryonal carcinomas (51 or 72.9% of 70 patients) which is consistent with their tendency to invade the adjacent structures aggressively. In contrast metastatic lesions occurred less frequently in the group of seminomas (47 or 50% of 94 patients) which often respect tissue planes as they enlarge.

In the over all picture of metastases the abdomino-aortic nodes were involved most frequently (87 cases) and no material difference was found in the frequency of their occurrence between the various types of testicular neoplasms. However there was a significant difference in the occurrence of parenchymal metastases. While metastases of seminomas remained confined to pre-aortic or iliac nodes in the majority of the cases, it was apparent that the parenchymal organs particularly the lungs were the site of metastatic lesions most often in cases of embryonal carcinoma, teratocarcinoma or chorioepithelioma. It ensues that general carcinomatosis was encountered more frequently in the latter group of cases (Table III)

TABLE IV.—TIME INTERVAL BETWEEN FIRST SYMPTOM AND DEVELOPMENT OF DEMONSTRABLE METASTASES

	Seminoma	Embryonal carcinoma	Teratocarcinoma	Miscellaneous	Total	Per cent
Under 6 mos.	16	30	4		50	44.5
7 to 12 mos.	0	5	4		9	17
1½ yrs.	6	2	2	1	11	24
2 yrs.	4	3	1		8	6.8
Over 2 yrs.	7	0	3		10	6.1
Not determined	4	2	1		7	6
	47	50	10	4	111	100

Further study of the occurrence of metastases indicated that the time elapsing between the onset of symptoms and first recognized metastases was less than 6 months in 52 or 44.5 per cent of the 117 cases. During the second 6 months the incidence dropped to 20 or 17.1 per cent. From then on a more definite decrease was noted (9.4% in from 1 to 1½ years, 6.8% in from 1½ to 2 years) but after a 2 year period metastases still occurred in 19 or 16.2 per cent of the patients. (In 7 cases the time interval could not be determined.) A seemingly significant observation was that metastases developed much earlier in the embryonal carcinoma group (58.8% of 51 cases during the first 6 months) than in the seminoma (34% of 47 cases during the first 6 months) (Table IV).

Of the 117 patients with metastases 95 (81.2%) died of the disease. The average duration of life after onset of symptoms was 23.2 months. It was longest in patients with seminoma (26.2 months) and shortest in the teratocarcinoma group (16.6 months).

TREATMENT

The generally accepted procedures in the treatment of testicular tumors are surgery and external irradiation. Preoperative deep x ray therapy of the primary tumor has been generally abandoned because it is considered of doubtful value for the following reasons: (1) Regional or distant metastases or both may develop while the patient is undergoing treatment. (2) a sterilizing tumor dose will render a histological diagnosis of malignancy

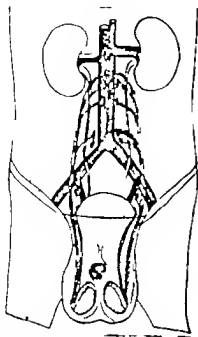


Fig. 6. Schematic drawing showing that lymphatics of the testicles drain into abdomino-aortic and external iliac lymph nodes.

fore it produces symptoms. Pain in the lower abdomen and groin represent the usual manifestations, but there are certain cases in which the primary tumor remains symptomless and the first and only evidence of the disease is produced by the development of distant metastases. Under these conditions it is often difficult to recognize the nature of the disease. In any case malignant degeneration of an undescended testicle should be included in the differential diagnosis of certain cases of metastatic carcinoma of unknown primary origin especially when metastases are found in the retroperitoneal space, lungs, or left supraclavicular region (Fig 5 a b c d). A positive Aschheim Zondek test may be of value in the establishment of the diagnosis in certain cases; however in others, an intra-abdominal testicle cannot be definitely identified as the site of the primary tumor before postmortem examination.

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TABLE III—SITE OF METASTASES IN 117 PATIENTS

	Semi-noma 47 patients	Embryonal carcinoma 30 patients	Teratocarcinoma 4 patients	Miscellaneous 6 patients	Total 117 patients
Pre-aortic nodes	36	30		2	87
Lungs	1	37	0	6	56
Cord and spermatic cord	15	8	1	3	37
Left supraclavicular nodes	10	0			
Mediastinum	11	0			10
Liver		3	1		16
Iliac fossa	1	4			15
Bones		3			4
General carcinoma type	1	0	7	1	37

ment of the ureter may indicate the presence of pre-aortic node involvement where palpation fails (Cahill)

Metastases were demonstrable in 117 or 57.9 per cent of our 202 patients. One hundred and eight of them had metastases at the time of admission and 9 developed metastatic lesions subsequently. The incidence of metastases was highest in the group of embryonal carcinomas (51 or 72.9% of 70 patients) which is consistent with their tendency to invade the adjacent structures aggressively. In contrast, metastatic lesions occurred less frequently in the group of seminomas (47 or 50% of 94 patients) which often respect tissue planes as they enlarge.

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TABLE IV—TIME INTERVAL BETWEEN FIRST SYMPTOM AND DEVELOPMENT OF DEMONSTRABLE METASTASES

	Semi-noma	Embryonal carcinoma	Teratocarcinoma	Miscellaneous	Total	Per cent
Under 6 mos	16	30	4	2	52	44.5
7 - 12 mos	0	5	4	1	10	17
1 - 1½ yrs.	6	2	2			9.4
1½ - 2 yrs.	4	3	1		8	6.8
Over 2 yrs.	7	0	3		10	16
Not determined	4		1		5	6
	47	5	5	4	17	100.0

Further study of the occurrence of metastases indicated that the time elapsing between the onset of symptoms and first recognized metastases was less than 6 months in 5 or 44.5 per cent of the 117 cases. During the second 6 months the incidence dropped to 20 or 17.1 per cent. From then on a more definite decrease was noted (9.4% in from 1 to 1½ years, 6.8% in from 1½ to 2 years) but after a 2 year period metastases still occurred in 19 or 16.2 per cent of the patients (In 7 cases the time interval could not be determined.) A seemingly significant observation was that metastases developed much earlier in the embryonal carcinoma group (58.8% of 51 cases during the first 6 months) than in the seminomas (34% of 47 cases during the first 6 months) (Table IV)

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TREATMENT

The generally accepted procedures in the treatment of testicular tumors are surgery and external irradiation. Preoperative deep x ray therapy of the primary tumor has been generally abandoned because it is considered of doubtful value for the following reasons: (1) Regional or distant metastases or both may develop while the patient is undergoing treatment (2) a sterilizing tumor dose will render a histological diagnosis of malignancy

impossible and (3) certain types of testicular tumors are radioresistant.

Removal of the primary tumor immediately following diagnosis is always indicated regardless of presence or absence of metastases. This procedure is justifiable in the presence of metastases because it eliminates a potential source of infection and possible further dissemination of viable tumor cells from the primary focus.

In carrying out orchidectomy the spermatic cord should be freed, ligated and cut at the level of the internal inguinal ring following which the testicle and cord are removed *en masse*.

The value of routine retroperitoneal lymph node dissection as a means to improve results is still undecided. This type of operation has generally been carried out by Hinman (10) as well as Chevassu and others. In more recent years however with the improvement in the technique of irradiation therapy Hinman and Powell's (12) indications for the radical operation have undergone certain revisions in favor of radiation. This is especially so in the group of the more radiosensitive seminomas. Further support to this view is expressed by Nash and Laddy who state as follows: At present it (radical orchidectomy) seems to be reserved only for those patients who have malignant testicular tumors, who are in good physical condition without evidence of metastases and who have a radio-resistant tumor either with or without hormone in the urine.

Recent investigations by Lewis have stimulated a renewed interest in this controversial subject. During the past few years, Lewis had the opportunity to treat and follow up a large number of patients who were treated in three different ways namely orchidectomy plus irradiation, radical orchidectomy alone. Lewis, himself has stated that the follow up is as yet too short to permit definite conclusions but his investigations when completed will be of great value inasmuch as they are apt to determine the superiority of any one of the 3 methods in the treatment of the various types of testicular tumors.

For the present, we are of the opinion that the radical operation followed by x-ray therapy should be reserved in general for patients with the more radioresistant neoplasms, while simple orchidectomy plus irradiation should be employed in the group of radiosensitive seminomas.

Postoperative x radiation is indicated in all patients regardless of absence or presence of metastases. If no metastases are demonstrable, treatment is given over 3 separate areas namely lower abdomen and groin of the affected side, epigastrium, and mediastinum. Not less than 2000 r (with backscatter) should be delivered to the depth of each of these areas in cases in which histologic and biologic behavior suggests a radiosensitive neoplasm. But more than 2000 r should be delivered in tumors of the more radioresistant group.

If metastases are present at some other location these should be treated first. It often is then indicated to cross-fire through multiple fields in order to insure maximum irradiation effect at the site of the lesion. In these cases, it is important to keep in mind that treatment of the metastatic focus must be followed by irradiation of the groin, retroperitoneal space and mediastinum. In other cases in which metastases are found in mediastinum or abdomino-aortic nodes, irradiation should be given first to the lesion most distant from the primary tumor.

It is desirable in these cases to hospitalize the patients while they are under treatment and close co-operation between radiologist and urologist is essential in determining dosage, field size, and irradiation technique for each individual case. During treatment the effect of x ray therapy on metastases must be evaluated by daily examinations supplemented by x ray films when necessary and the plan of treatment must be modified as required by response or failure of therapy (Fig 8 a and b). In certain cases, it may also become necessary to direct additional treatment to a previously uninvolved area, because new metastases may develop while old ones are still being irradiated.

It is imperative in these cases to deliver in one course an adequate amount of irradiation.



Fig. 8. a, Extensive multiple metastases to both lungs before deep x ray therapy
b, Few metastatic foci remain, but elevation of right diaphragm suggests liver involvement.

to metastases in order to accomplish their disappearance when possible. While it is undoubtedly true that some seminomas show satisfactory response to dosages of less than 2000 r it has been our observation that others require more to obtain similar results (Table V). This statement is borne out by the fact that 42 or 79.2 per cent of 53 metastatic patients receiving less than 2000 r showed little or no response to treatment as compared to 9 or 19.1 per cent of 47 patients receiving in excess of 2000 r. These figures indicate that even in apparently radiosensitive tumors a dosage of under 2000 r should not be considered an adequate amount in the treatment of metastases. It has more recently become our practice therefore, to deliver larger dosages (2500 to 3500 r) in order more effectively to influence the course of the disease.

Our studies have led us to believe that success or failure of irradiation therapy particularly in metastatic cases depends almost entirely upon two factors namely (a) radiosensitivity or responsiveness of the tumor and (b) proper technique of irradiation and adequate dose delivered during one course of treatment. If metastases fail to respond or if they recur following a period of disappearance palliation only has been accomplished and little or nothing can be expected from subsequent irradiation therapy. The same statement applies for those patients who develop

metastases following an initial course of prophylactic deep x ray treatment (Nesbit). Also the introduction of supervoltage irradiation has not materially altered the prognosis in these cases.

The great majority of our patients were referred to the Roswell Park Memorial Institute after they had undergone simple orchiectomy elsewhere and only 14 of the patients were admitted with the primary lesion still present. Seven of them were nonmetastatic at the time of operation and the other 7 had distant metastases. The method or methods of treatment employed were consistent in general with the principles aforementioned.

END-RESULTS

The end results obtained in our series of 202 patients are summarized in Table VI

TABLE V --EFFECT OF RADIATION DOSAGE IN 100 PATIENTS WITH METASTASES

	Cure	Temporary disappearance	Marked temporary regression	Little or no response	Total
Under 2000r				2	
2000-3000r	7	1	3	40	5
3000-3500r		10	4	3	17
Over 3500r		4	3	6	13
	19	15	15	51	100

Complete failure 42 or 79.2% of 53 patients receiving under 2000r
9 or 19.1% of 47 patients receiving over 2000r

TABLE VI.—END-RESULTS IN 202 CASES OF TESTICULAR TUMORS

	Died of disease	Died other causes	Alive and well	Alive with disease	Lost trace of	Total
Seminoma	33		56		3	92
Embryonal carcinoma	46		23			70
Teratocarcinoma						27
Choriocarcinoma						3
Adult teratoma			3			5
Miscellaneous						3
	92	3	96		6	202

Over-all cures 96 or 47.5% of 202 patients

5 year cures 70 or 48.0% of 43 patients admitted before 3-31-41

year cures 15 or 31.7% of 47 patients admitted before 3-31-50

Ninety six patients are alive and well 2 are alive with the disease 95 died of the disease 3 died of other causes and 6 were lost trace of. This represents an over all cure rate of 47.5 per cent a 5 year cure rate of 48.9 per cent (70 of 143 patients admitted before December 31 1941) and a 10 year cure rate of 34.7 per cent (35 of 101 patients admitted before December 31 1936).

Our figures indicate further that regardless of the type of tumor death of the disease occurred most often during the first 2 years after onset of symptoms. The mortality rate for this period was 68.4 per cent (65 patients) with an approximately equal number of deaths occurring during the first (35 cases) and second year (30 cases). Hence the death rate showed a precipitous decrease to about 10 per cent for each of the following 3 years (9.4% during 3rd and 4th year 10.4% during 5th year). Only 3 patients who survived the 5 year period died of the disease after 6 7 and 11 years respectively. It ensues that any study based on 2 year follow up is subject to over 30 per cent error while any study based on 5 year follow up is subject to only 3 per cent error. Accordingly one is justified to conclude that any patient surviving 5 years and more can be considered almost safe from the possibility of recurrent disease.

An analysis of the end-results obtained in the various types of tumors revealed that the end results were most favorable in the seminoma group (59.6% over all cures) less favorable in the teratocarcinoma group (44.4%

TABLE VII.—SEMINOMA END-RESULTS

	Died of disease	Died other causes	Alive and well	Lost trace of	Total	Per cent
No lymphoid stroma	6		4			1
Little lymphoid stroma					21	55.1
Moderate lymphoid stroma	0		24		24	56
Abundant lymphoid stroma	6		17		23	56.1
	12		25	3	40	100

Over-all cures 56 or 59.6% of 94 patients

5 year cures 30 or 57.4% of 52 patients admitted before 12-31-41

year cures 15 or 44.5% of 40 patients admitted before 12-31-50

over all cures) and least favorable in the patients with embryonal carcinoma (31.9% over all cures). The number of our patients with choriocarcinoma, adult teratoma, or miscellaneous cell type tumor was too small to permit conclusions. The results in these cases were in agreement with well-known facts which indicate that choriocarcinomas offer an extremely poor prognosis, while adult teratomas have a comparatively high survival rate.

SEMINOMA

Fifty six or 59.6 per cent of our 94 patients with seminoma were alive and well at the time writing with a 5 year cure rate of 57.4 per cent and a 10 year cure rate of 44.5 per cent. It was found that the prognosis in this type of neoplasm was influenced to a large extent by the amount of lymphoid stroma encountered in the tumor bed. Of 35 patients with seminoma containing no or little lymphoid stroma, 18 or 51.4 per cent died of the disease and 15 or 42.8 per cent survived. In contrast, it was found that only 15 or 25.4 per cent of 59 patients of the other group were dead and 44 or 69.6 per cent were alive and well (Table VII). This confirms observations previously reported from this institution (Heger and Thibaudau).

It has been in the group of seminomas where irradiation therapy was found to be most effective. Although some of these tumors proved to be radioresistant, there were others which were not only radiosensitive but even radio-

TABLE VIII.—EFFECT OF SEMINOMATOUS TISSUE IN EMBRYONAL CARCINOMA ON PROGNOSIS

	Died of disease	Alive and well	Lost trace of	Total	Per cent
Embryonal carcinoma	30	9		40	57.5
Embryonal carcinoma plus seminoma	16	14		30	47.0
	46	23	1	70	100.0

Over-all cure in embryonal carcinoma, 9 or 22.5% of 40 patients.
Over-all cure in embryonal carcinoma plus seminoma, 14 or 47% of 30 patients.

curable. Permanent disappearance of metastatic lesions was attained by deep x ray therapy in 13 or 27.7 per cent of 47 cases. Eleven other patients responded either with temporary disappearance (6 cases) or marked temporary regression of metastases (5 cases).

EMBRYONAL CARCINOMA

Twenty three or 32.9 per cent of 70 patients with embryonal carcinoma were alive and well at the time of writing with a 5 year cure rate of 35.7 per cent and a 10 year cure rate of 26.8 per cent. However analysis of these results revealed that the prognosis in this type of tumor was significantly influenced by presence or absence of seminomatous tissue. The survival rate was 46.7 per cent in 30 patients with tumors comprised of embryonal carcinoma with seminoma while it was only 22.5 per cent in 40 patients with tumors consisting of embryonal carcinoma exclusively (Table VIII).

In contrast to the seminoma group our findings were that the amount of lymphoid stroma had no significant influence on the prognosis in patients with embryonal carcinoma, regardless of presence or absence of seminomatous tissue.

The response of metastases to irradiation therapy was generally poor in patients with plain embryonal carcinoma but appreciably better if the tumor contained an admixture of seminomatous cell elements. In 51 cases of metastatic embryonal carcinoma only 5 or 9.8 per cent showed permanent satisfactory response. Four of these patients had embryonal carcinoma plus seminoma and only 1 had embryonal carcinoma exclusively. Thirteen other patients responded with either tempo-

rary disappearance (7 cases) or marked temporary regression of the metastatic lesions (6 cases).

TERATOCARCINOMA

The number of teratocarcinomas in our series was not large enough in our opinion to permit of a conclusive evaluation. Twelve or 44.4 per cent of 27 patients were alive and well at the time of writing with a 10 year cure rate of 14.3 per cent. (The 5 year cure rate in this group was 72.7 per cent, but on account of the small number of cases no significance should be attached to this coincidental figure.) It was found that the type of malignant cell elements associated with the adult part of the tumor did not alter the prognosis in the cases of our series.

Teratocarcinomas are radioresistant with rare exceptions. Only 1 or 6.6 per cent of 15 metastatic patients responded with permanent disappearance of metastases, while 4 showed either temporary disappearance (1 case) or marked temporary regression (3 cases).

COMMENT

It was one of the principal objects of our investigations to determine to what extent it is possible to correlate histopathological findings and biological behavior of various testicular tumors. To this end we adopted the recently advocated simplified classification of Friedman and Moore as a basis for our studies although we were fully aware that this classification does not meet all the requirements to satisfy the embryologist, pathologist and clinician alike. Nevertheless, in spite of certain shortcomings, we considered this new classification helpful because of its simplicity and if generally accepted it might promote a more common understanding among various investigators.

We agree with Friedman and Moore that it is advantageous for practical purposes, to omit a comparatively small group of rarely encountered neoplasms from a commonly used classification because the inclusion of these rare types of tumors must lead to confusion. In general we have been able to confirm their observations which are that the great majority of testicular tumors follows 4

CORRECTION OF HYPOPROTEINEMIA BY THE ADMINISTRATION OF PLASMA AND BLOOD

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SEVERAL recent authors consider that intravenous plasma therapy is not an efficient and practical means of elevating the plasma proteins in the hypoproteinemic patient (1, 3, 8, 11, 13). This point of view is reflected in Elman's (1) recent statement in which he concludes that "As long as the surgeons are confronted with the patient who cannot take and assimilate adequate protein nourishment through the gastrointestinal tract the parenteral injection of appropriate amino acid mixtures is the only method of preventing and correcting protein starvation during such periods." Further search of the literature however suggests evidence that plasma and blood may be of value for this purpose.

Holman, Mahoney and Whipple (9) reported that dogs on a nitrogen free diet, when given intravenous plasma and sugar were maintained in positive nitrogen balance. These animals metabolized the administered plasma without increased nitrogen loss although only 3 to 15 per cent of the injected plasma protein remained in the circulation 7 to 10 days after injection. They postulated that the remaining 85 per cent was recast as tissue protein without nitrogen loss. Specific human data of this type in which large and repeated infusions of plasma have been administered, are insufficient to permit definite conclusions as to the efficacy of plasma in elevating the plasma proteins, etc. In a recent editorial on blood plasma, however Snyder stated that "In wartime plasma was used extensively to correct and prevent hypoproteinemia—it became routine practice to give these patients 500 to 1000 cubic centimeters

of plasma daily besides the whole blood needed. Plasma protein determinations by the copper sulfate specific gravity method indicated that 500 to 750 cubic centimeters of plasma daily were sufficient to maintain a satisfactory level in most patients of this sort.

We are reporting the results of a study in which the hypoproteinemic patients were given large volumes of plasma in an endeavor to elevate the plasma proteins. Whole blood was sometimes given to correct anemia, but in all but 2 patients the greatest source of parenteral protein was plasma. These last 2 patients (1 and 8) were carried on plasma and blood to correct the preoperative hypoproteinemia later when the hypoproteinemic state reappeared in the postoperative period, amigen was given instead of plasma, and the relative efficiencies of these two sources of nitrogen as corrective agents, were compared.

METHODS

The plasma proteins were determined in duplicate by the macro-Kjeldahl method (3). The daily nitrogen loss in the urine and stool was determined by the micro-Kjeldahl procedure (5). When nitrogen loss was augmented by gastric aspirations or weeping wounds, these excreta were also taken into consideration. The hematocrit reading was made on heparinized blood centrifuged at 2,800 revolutions per minute for 20 minutes. Hemoglobin determinations were measured in the Evelyn colorimeter (4). Plasma volume was measured by the Evans blue dye method (8) samples being drawn at 10, 20 and 30 minutes after dye injection. Blood loss at operation was also considered, the principle of Gatch and Little being used (6). Erythrocyte and leucocyte counts were made daily.

Six of the 9 patients reported here were in hospital rooms where facilities for metabolic

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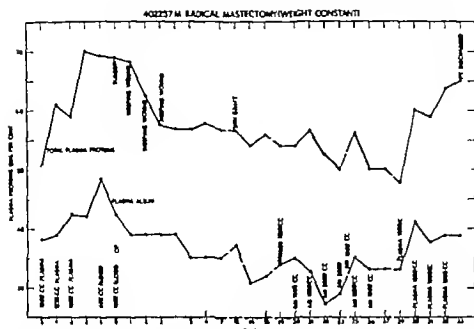


Fig. 1 Case 1 No 402357 Plasma protein and plasma albumin record. Radical mastectomy Weight constant.

studies were available. All food items taken orally and parenterally were recorded in terms of grams of nitrogen, carbohydrate and fat. Various vitamin supplements were administered daily. Aside from the iron contained in the diet, no supplements of iron or liver were given. In these 6 cases it was possible during the greater part of the period of analysis to obtain complete collections of urine, stools, gastric juices, and to analyze these and the dressings for nitrogen loss. Three of the 9 patients were not on nitrogen balance studies.

Because of the critical nature of the hypoproteinemic patient, it was felt that where possible, oral feedings should be encouraged. In some cases either no food was ingested or the oral intake was meager. The amount of nitrogen taken by each patient has been tabulated and the route of administration is indicated.

PRESENTATION OF DATA

CASE 1 No 402357 A 56-year old housewife had carcinoma of the left breast with metastases to both axillae. Over an 18 month period she had received a course of x-ray therapy that resulted in necrosis of the left breast. Her weight had remained constant and her dietary intake fair.

Her hospital stay from the laboratory viewpoint was divided into seven periods, the nature of which are shown in Table I. The first period shows a prompt rise in the plasma protein concentration from

5.1 grams per cent to 7.0 grams per cent after 3 days of plasma administration totalling 4,400 cubic centimeters. At the end of this period the total circulating plasma proteins were increased from 97 grams to 182 grams. The plasma volume was increased from 1,970 cubic centimeters to 2,600 cubic centimeters and there was a positive nitrogen balance of 99 grams.

After radical resection of the left breast complete skin closure was not possible, so that the dressings were moistened by the serosanguineous drainage. This drainage, coupled with the excretion of both urine and stool nitrogen, averaged 4.6 grams per day for 9 days exactly offsetting the oral intake of 4.6 grams nitrogen per day which was the only source of nitrogen given during this period. The total circulating plasma proteins were reduced from 182 grams to 169 grams and the plasma protein concentration fell from 6.9 grams per cent to 5.9 grams per cent by the ninth postoperative day.

On that day the wound was covered with a dermatome skin graft. For the next 6 days her oral nitrogen intake was reduced to 2.1 grams daily as her appetite had waned. She entered into a negative nitrogen balance averaging 4.0 grams per day but without significant change in the total circulating plasma proteins or their concentration. Presumably her plasma proteins were being maintained at the expense of the body proteins during this period.

In an attempt to overcome the negative nitrogen balance, 5 per cent amigen and 5 per cent dextrose were given the average being 1,400 cubic centimeters (or 11 gm. of nitrogen) per day for 8 days. The amigen, combined with a small daily oral nitrogen intake resulted in a positive nitrogen balance of 17 grams per day. Despite this the plasma protein concentration fell from 5.7 grams per cent to 4.8 grams

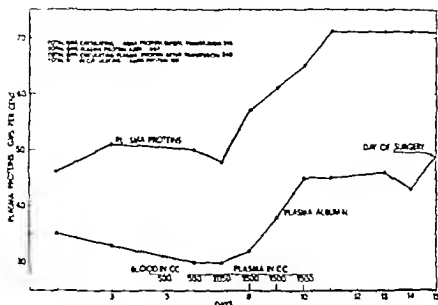


Fig. Daily plasma protein and plasma albumin record in Case 1, No. 308633. A gastroenterocolic fistula followed gastroenterostomy and patient lost 30 pounds.

per cent. Plasma was then substituted for amigen and 1,000 cubic centimeters (or 9 gm. of nitrogen) a day were given for 4 days thereby restoring the plasma protein concentration from 4.8 grams per cent to 6.3 grams per cent and increasing the total circulating plasma proteins from 163 grams to 240 grams. The positive nitrogen balance was increased from a daily average of 1.7 grams to 6.8 grams. Three days later she was discharged at which time her plasma protein concentration still remained at 6.3 grams per cent (see Fig. 1).

CASE 2, No. 308633. A 29 year old male was admitted with a diagnosis of gastrocolic fistula of 10 months duration complicating a 21 ma ulcer following a gastroenterostomy for duodenal ulcer. Undigested food particles were present in the stools, and the patient had lost 13.5 kilograms (30 lbs.) in weight despite the fact that he had had a voracious appetite and had ingested large amounts of food. For convenience of presentation his hospital stay has been divided into seven periods, as shown in Table I.

The first was a control period of 4 days in which the patient was allowed a full oral diet. An average positive nitrogen balance of 1.3 grams was achieved, and the plasma protein concentration was elevated from 4.6 grams per cent to 5.0 grams per cent. The total circulating plasma proteins were also essentially unchanged.

During the second period of 6 days he was given daily infusions of plasma, totalling 7,000 cubic centimeters in addition to his oral diet. The positive nitrogen balance was increased from 1.3 grams per day to 14 grams per day. The plasma protein concentration was increased from 5.0 grams per cent to 7.1 grams per cent and the total circulating plasma proteins were raised from 235 grams to 355

grams. After closure of the fistula he received no nitrogen, either orally or intravenously for 4 days during which time he was given glucose and saline. The result was a negative nitrogen balance of 13.3 grams. Some of this negative balance was due to the presence of gross blood in the stool. During this time the total circulating plasma proteins declined from 355 grams to 306 grams and the plasma protein concentration fell from 7.1 grams per cent to 6.0 grams per cent. In the next, or fifth period, the patient was given feedings with an average daily intake of 8.2 grams of nitrogen for 7 days. The plasma protein concentration increased from 6.0 grams per cent to 6.3 grams per cent, but this increase was relative as the patient had been overhydrated and then dehydrated, as shown by the plasma volume reduction from 5,175 cubic centimeters to 3,840 cubic centimeters so that his total circulating plasma proteins actually fell from 306 grams to 239 grams. At the end of this period a subdiaphragmatic vagotomy was done in treatment of the ulcer and the eight day postoperative period was characterized by weight gain, a positive nitrogen balance of 2.3 grams per day and a decrease of the total circulating plasma proteins from 239 grams to 384 grams. He was discharged on the ninth postoperative day and 5 months later had gained 60 pounds. Daily changes in the plasma protein concentration are shown in Figure 2.

CASE 3, No. 401432. A 60 year old male was admitted to the hospital with a diagnosis of carcinoma of the stomach and a history of 27 kilograms (61 lbs) weight loss in 4 months. A subtotal gastrectomy was done and a transfusion of 600 cubic centimeters of blood was given during operation. No visible metastases were left behind. By the next postoperative day during which time he had received only glucose and saline intravenously.

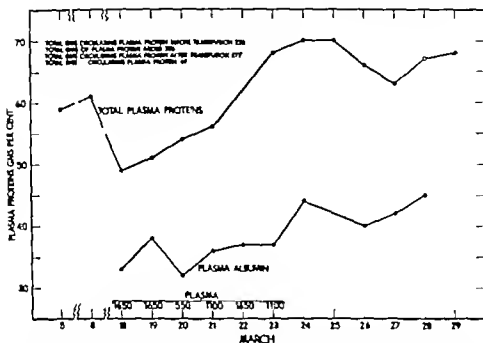


Fig. 3. Plasma protein and plasma albumin record Case 3, No. 41,432. Patient had lost 61 pounds in 14 months. Subtotal gastrectomy was performed for carcinoma.

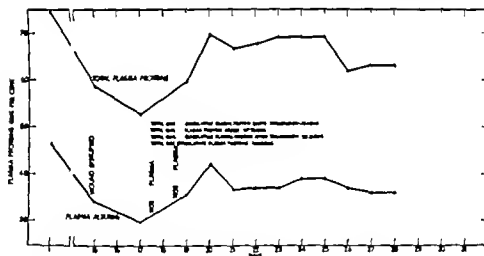


Fig. 4. Plasma protein and plasma albumin record in Case 4 No. 401,977. Cholecystectomy. Weight constant.

plasma protein concentration had fallen from 6.1 grams per cent to 4.9 grams per cent.

At this time nitrogen balance studies were instituted and the results are recorded in Table I. Both oral feedings and plasma infusions were begun and resulted in an average positive daily nitrogen balance of 6.5 grams. During this 6 day period he received a total of 7,700 cubic centimeters of plasma. His plasma protein concentration increased from 4.0 grams per cent to 7.0 grams per cent (see Fig. 3) and the total circulating plasma proteins were elevated from 152 to 245 grams.

During the second period, beginning the day after the last plasma infusions, all nitrogen was administered orally and averaged 11.5 grams per day.

Throughout this period a positive nitrogen balance averaging 5.9 grams was maintained and the total circulating plasma proteins and the plasma protein concentration were essentially unchanged. The patient was then discharged.

CASE 4. No. 401,977. A 67 year old female was admitted with a diagnosis of acute cholecystitis and cholelithiasis of 6 hours duration. These symptoms rapidly subsided and on the eleventh hospital day a cholecystectomy was performed. There was no history of weight loss nor was there weight loss during the first 11 days after operation had been performed although her hospital diet was protein poor. The patient was afebrile and the leucocyte count remained normal.

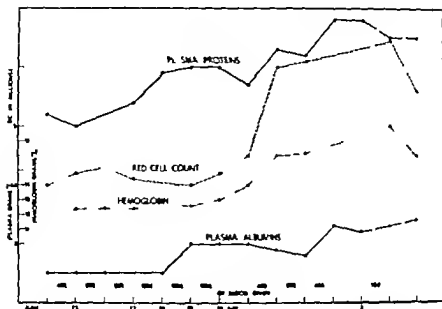


Fig. 5. Plasma protein, red cell count, hemoglobin, and plasma albumin, in Case 5, No. 135,655. Bleeding duodenal ulcer.

The postoperative period was complicated by an upper respiratory infection with coughing and a thrombophlebitis for which dicumarol was given beginning on the seventh postoperative day. On the ninth postoperative day her wound disrupted and was immediately closed. Two days later the plasma protein concentration was 5.3 grams per cent and on this day nitrogen balance studies were begun (see Table I). A total of 2,750 cubic centimeters of plasma was administered intravenously which increased the plasma protein concentration from 5.3 grams per cent to 7.0 gram per cent (see Fig. 4) and raised the total circulating plasma proteins from 95 grams to 210 grams. During these 2 days there was a positive nitrogen balance of 20 grams per day.

During the next 8 days she was given no intravenous nitrogen but her oral nitrogen intake remained good. A positive daily balance of 31 grams was maintained and the plasma protein concentration and the total circulating plasma protein levels were essentially unchanged.

CASE 5, No. 135,688. A 44 year old male was admitted with a diagnosis of a duodenal ulcer with intermittent bleeding for 1 month and perforation of ulcer sutured 17 days previously resulting in subdiaphragmatic abscess. After 11 days of study antibiotic therapy and blood transfusions totaling 3,600 cubic centimeters a trans thoracic drainage of the abscess was done. The infection repeated hemorrhages and low food intake had resulted in a reduction of the plasma protein concentration of 5.2 grams per cent.

Three days after the drainage operation nitrogen studies were begun (see Table I) and whole blood was transfused daily for 12 days excepting the sev-

enth and eleventh—totaling 7,200 cubic centimeters in an effort to correct anemia and hypoproteinem. Contrary to expectations the total blood volume determined daily before each transfusion for 12 days (omitting the fifth and sixth days) showed no increase until after the seventh day or not more than 500 cubic centimeters of blood had been given. This quantity of blood was approximately 1 per cent amount of his calculated blood volume (see Table IV). At the end of this time however it had increased only 900 cubic centimeters which is counted for approximately 15 per cent of the total amount transfused. Thereafter the blood volume remained between 3,300 and 3,500 (see Table II) until the patient was discharged 9 days after the last transfusion.

During the transfusion period an average daily positive nitrogen balance of 20 grams was maintained. The plasma protein concentration was increased from 5.2 grams per cent to 6.8 grams per cent, although the total circulating plasma proteins were not greatly elevated (78 gm. to 102 gm.). The daily average oral nitrogen intake during this period was 11 grams. Nitrogen balance studies were continued for 9 days after the last transfusion. A positive nitrogen balance was maintained and a raised 3.9 grams daily. The plasma protein concentration and total circulating plasma protein were essentially unchanged.

CASE 6, No. 106,174. A 75 year old female was admitted with severe debility, anemia, malnutrition and draining sacral decubitus ulcer 8 weeks after she sustained a subtrochanteric fracture of the left femur which was slowly uniting. She was studied through four periods (see Table I). Nitrogen balance was

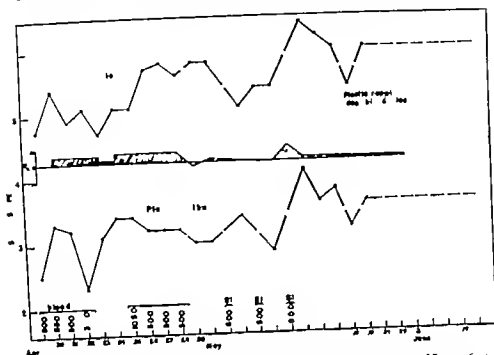


Fig. 6. Plasma proteins and plasma albumin record in Case 6. No. 406,174. Unlimited fracture of left femur. Decubitus ulcer of sacrum. Severe debility.

urements were instituted and for 4 days the patient received whole blood transfusions totalling 1,050 cubic centimeters. A positive nitrogen balance of 12.8 grams was obtained although the plasma protein concentration remained essentially unchanged (Table I and Fig. 6) and there was little elevation of the total circulating plasma proteins and total plasma volume.

During the next 3 days the patient received only oral nitrogen which resulted in a slight negative nitrogen balance. There was no change in the plasma protein concentration or total circulating plasma proteins. During the next 4 days the patient received a total of 2,550 cubic centimeters of plasma which resulted in a return to a positive nitrogen balance and an elevation of the plasma protein concentration from 5.1 grams per cent to 5.6 grams per cent. The total circulating plasma proteins were raised from 142 grams to 179 grams.

For the next 13 days the patient received only oral nitrogen which again resulted in a slight negative nitrogen balance although the plasma protein concentration was maintained above 6.0 grams per cent. Due to the lack of suitable veins to procure samples, figures for plasma volumes and total plasma protein values are not available for this period.

CASE 7. No. 343,601. A 64 year old female had a sudden onset of severe epigastric pain and frequent emesis of small amounts of fluid 7 hours prior to admission. She had previously been in good health. An exploratory laparotomy disclosed acute hemorrhagic pancreatitis. Cholecystostomy was performed. On the seventh postoperative day with continued emesis the wound disrupted and was resutured. She was unable to take an oral diet aside from a small amount during the first week and was

maintained on intravenous injections of plasma, blood, glucose, minerals and vitamins. There was continuous drainage from the cholecystostomy for 10 days and from the pancreatic region until death.

The initial laboratory data showed a red cell count of 5.4 million and a white cell count of 17,000. The plasma protein level however was 4.6 grams per cent 2 days following operation. The blood and

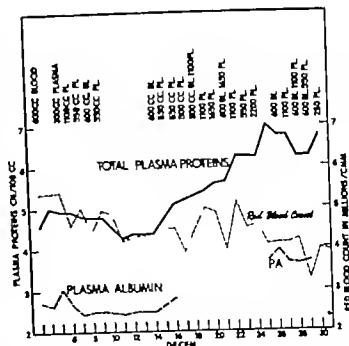


Fig. 7. Plasma protein response to blood and plasma transfusions. Pancreatitis and wound disruption. Case 7. No. 343,601.

TABLE 1—SUMMARY OF PROTEIN METABOLIC STUDIES ON PATIENTS RECEIVING PLASMA AND ON BLOOD TRANSFUSIONS

Patient N and Unit No	Average daily nitrogen intake in gm			Average daily nitrogen excretion in gm	Average daily nitrogen balance	Plasma protein concentration as gm. %		Total circulating plasma protein in gm.		Plasma volume in		Hematocrit percentage	
	Oral	I.V.	Total			1st day	Last day	1st day	Last day	1st day	Last day	1st day	Last day
8 M. K. No 40217 Period 3 days plasma precursor free. Total 4,000 grams	1	0	7.0	8	0.9 pos	1	7	97	184	1970	2600	41	31
Period	Radical mastectomy—blood loss measured 160 c.c. given 300 c.c. during operation.												
Period 3 9 days w. wrapping wound after operation	4.0		4.0	4.0		6.0	5.0	13	169	2750	2600	41	31
Period 4	Dermatome skin graft placed over breast wound. Given 600 c. blood. Lost 30 blood												
Period 5 8 da after skin graft				6	4 neg	1.0	1.7	60	176	2600	3150	38	31
Period 6 8 da of serum infusions	4	0	3	3	7 pos	3.7	4.8	176.7	63	3100	3400	36	31
Period 7 4 da of plasma infusions	8	8	16	8.3	6.8 pos	4.8	6.3	163	240.3	3400	3700	33	31
Patient discharged 3 days later													
E. R. No 40615 Period 4 da control period	0.8		0.8	8.5	1 pos	4.6	5	235.4	235	4900	4790	40	31
Period 6 da of plasma infusions Total 700	6.6	5	10	5	1.4 pos	5	7	30	233	4790	3000	44	31
Period 3	Closure of enterocolic fistula. Blood loss measured 322 c. Blood received 1800 c.												
Period 4 4 da intravenous glucose and saline only				gross blood in stool 3.3	3.3 neg	7	6	233	306	3000	3300	48	31
Period 5 7 da oral feedings only	8	8	16	10	0.8 neg	6	6.3	306	30	2190	3240	34	31
Period 6	Vagotomy. Blood loss measured 455. Blood given at operation 600 c.												
Period 7 8 da postoperative until discharge	4		4		3 pos	6.3	6.4	30		2190		40	
3 J. L. No 40143 Period 1. 6 da of plasma infusions. Total 7700 c.c.	10		10	3.6	6.3 pos	4.0	7	51.7	245	3390	3300	35	31
Period 3 6 da post last plasma infusion	5		5	7.0	3.9 pos	7	6.8	245	263	3300	3000	30	31
4 M. L. N 40177 Period 1. 6 da plasma infusions Total 4790 in 30 hrs	13.5	10.8	24.3	3	20 pos	5.3	7	95.4	210	800		40	31
Period 8 da post last plasma infusion	13.3		13.3	0	3 pos	7.0	6.0	3		3000	1800	34	31

plasma given in the course of treatment are shown in Figure 7.

During the first week the patient received two 600 cubic centimeter blood transfusions and on 4 of the days she received plasma injections totalling 500

cubic centimeters. On the fifteenth postoperative day with an abundant supply at hand plasma and blood transfusions were renewed, and continued until the time of death on the twenty-eighth day. She received daily plasma transfusions totalling 14,000

TABLE I.—SUMMARY OF PROTEIN METABOLIC STUDIES ON PATIENTS RECEIVING PLASMA AND OR BLOOD TRANSFUSIONS—Continued

Patient No. and Unit No.	Average daily nitrogen intake in gm.			Average daily nitrogen excretion in gm.	Average daily nitrogen balance	Plasma protein concentration as gm. %		Total circulating plasma protein in gm.		Plasma volume in c.c.		Hematocrit percentage	
	Oral	IV	Total			1st day	Last day	1st day	Last day	1st day	Last day	1st day	Last day
S. L. B. No. 135668 Period 1 Drainage of subdiaphragmatic abscess													
Period 2. 1 da. of whole blood transfusion Total of 7100 c.c.	1.2	20.0	21.2	2.5	20.6 pos.	5.2	6.8	780	103	130	1510	38	5
Period 3. 9 da. post last blood transfusion	12.0		20	8.1	19 pos.	6.8	6.5	952	105	1470	1785	51	40
6. M. V. No. 400774 Period 1. 4 da. whole blood transfusion Total of 3090 c.c.													
	8.7	14.9	23.6	10.8	22 pos.	4.8	5.1	124.8	122.8	2640	2860	34	48
Period 2. 1 da. oral feeding only	7.4	0	7.4	9.0	6 neg.	5	5	122.8	40.8	2860	286	48	47
Period 3. 4 da. plasma infusion Total of 350 c.c.	6.4	7.6	14	8.1	5.9 pos.	5	5.6	140.8	170	86	3300	47	43
Period 4. 13 da. post last plasma infusion	8		8	8.4	0.4 neg.	5.6	6.4	Unable to obtain total figures due to veins being unsuitable to procure blood volumes					

cubic centimeters giving a daily average of 1,000 cubic centimeters plasma. Near the end of this period the plasma protein concentration had been elevated to 6.8 grams per cent, and the albumin was increased from 3.7 to 3.8 grams per cent (see Fig. 7). On the twenty first postoperative day she had a transfusion which was followed by jaundice and generalized edema persisting until death. Nitrogen balance studies were not made.

CASE 8. No. 362409. A 47 year old male had a gastroenterostomy performed for duodenal ulcer 6 years prior to admission here. One year following operation he developed diarrhea and began to lose weight. In the past 2 years he had lost 60 pounds in spite of an adequate diet. He was continued on a similar high caloric and high protein intake during his preoperative stay in the hospital. His stools however contained undigested food.

The initial laboratory data disclosed a plasma protein concentration of 3.4 grams per cent with an albumin level of 2.7 grams per cent. Eleven thousand cubic centimeters of plasma and 5,300 cubic centimeters of blood were administered over an 11 day period. The rapid rise in plasma protein level is seen in Figure 8 although 3,800 cubic centimeters of blood and plasma were given before any appreciable effect in the plasma protein concentration was achieved. A subtotal gastric resection gastrojejunostomy and partial colectomy were performed to eradicate the gastrocolic fistula and stoma ulcer. An unsuccessful attempt was made to sustain the plasma protein concentration by the use of amigen alone dur-

ing the first 10 postoperative days (see Fig. 8) although an average of 2,400 cubic centimeters of amigen was given daily during this time. However the plasma proteins fell from 6.2 grams per cent to 4.1 grams per cent. The plasma protein concentration rose when plasma oral feedings and amigen were again given. Nitrogen balance studies were not made.

CASE 9. No. 379854. A 74 year old male entered the hospital with a diagnosis of carcinoma of the cardiac end of the stomach. He reported a weight loss of 16 kilograms (35 pounds) in the previous 9 months.

TABLE II.—PLASMA PROTEIN CHANGES FOLLOWING PLASMA TRANSFUSIONS

Patient	Total grams plasma protein transfused	Transfusion period in days	Total circulating plasma protein pre-transfusion	Total circulating plasma protein 16 to 24 hrs. after last transfusion	% of transfused plasma protein associated for by the increase in total circulating plasma protein
1	242	3	97	83	64
2	385	6	30	355	62
3	483	6	15	245	78
4	51	2 (30 hrs)	95	21 (8 hrs)	53
6	37	4	42	179	71

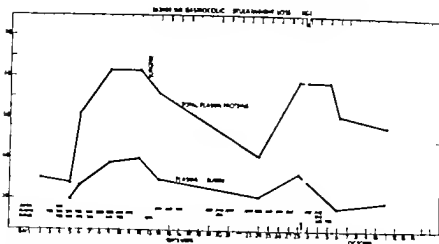


Fig. 8. Plasma proteins and plasma albumin record in Case 8, No. 363,400. Patient lost 60 pounds in the years previous to admission.

The initial plasma proteins were 4.6 grams per cent with an albumin of 2.8 grams per cent. Five liters of plasma were administered over a 5 day period. At the end of this time the plasma proteins were 9.9 grams per cent. He was then maintained on a liquid oral feeding for 10 days and given 5 plasma injections totalling 1,400 cubic centimeters. A trans-thoracic esophageal resection was then performed during which 1,500 cubic centimeters of blood were given as replacement. Five days after surgery the plasma proteins had declined to 4.9 grams per cent. Five hundred cubic centimeters of plasma were given daily on the seventh, eighth and tenth postoperative

days. On the tenth postoperative day the plasma protein concentrations were 6.2 grams per cent (see Fig. 9). He was discharged on the thirteenth postoperative day. Nitrogen balance studies were made.

DISCUSSION

The plasma protein concentration of the patients reported in this study was significantly elevated by the administration of adequate amounts of plasma and blood. The ease with which the normal plasma protein concentration was restored, seemed more closely related to the extent of the starvation period than to the pretransfusion plasma protein concentration. For examples, in patients 1 and 4 whose nutritional states were relatively good a rapid rise in the plasma proteins was obtained when 2750 and 4400 cubic centimeters of plasma was administered over a 1 and 3 day period respectively. On the other hand in patient 6 in whom a long debilitating disease with a decubitus ulcer and marked weight loss had been present the rise in plasma protein concentration after the administration of 2550 cubic centimeters of plasma was slight. It was also difficult to elevate the plasma protein concentrations in patients 2 and 3 who had lost considerable weight (27 and 60 pounds) prior to their hospital admission. In these starved patients 4,000 to 5,000 cubic centimeters of plasma was given over 6 days before any elevation in the plasma protein concentration was detected. Similar difficulties were encountered in patient 9 (see Fig. 9).

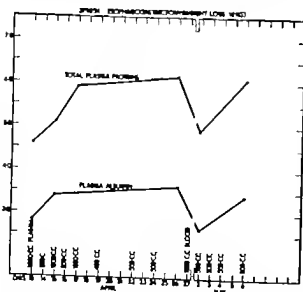


Fig. 9. Case 9, No. 379,854. Patient had lost 35 pounds in 9 months. Entered hospital with diagnosis of carcinoma of cardiac end of stomach. Chart shows total plasma proteins and plasma albumin.

TABLE III—BLOOD PROTEIN CHANGES FOLLOWING BLOOD TRANSFUSION

Patient No. 135688	Total grams blood protein transfused	Transfusion period in days	Total cir- culating blood protein pretrans- fusion	Total cir- culating blood protein after last transfusion	% of trans- fused blood incorporat- ed for by the increase in total circulat- ing blood protein
	1396		403	738	99

The total circulating plasma proteins were calculated at intervals on the basis of the circulating plasma volume and the plasma protein concentration. A knowledge of this figure is essential to the proper interpretation of the patient's response to the injected plasma or blood in the hypoproteinemic state since at times variations in the plasma protein may be more apparent than real. In fact, an elevation may result from plasma concentration when actually the total circulating plasma proteins may be reduced (see Table I patient 2 period 5).

A positive daily nitrogen balance was maintained during the period of blood or plasma therapy in all 6 patients on balance studies. In patients 4 and 5 this figure reached 20 grams per day. However 5 of the 6 patients on balance studies showed an increase in the total nitrogen excretion during the period of plasma or blood infusions, although this increased nitrogen excretion was relatively small compared to the increase in the total nitrogen intake. An average daily positive nitrogen balance of 12 grams was maintained during the period of plasma or blood administration. On the other hand the daily nitrogen balance during the periods immediately following the infusion period ranged from plus 4.0 grams to minus 13.0 (patient 2) and averaged minus 7.0 grams. This figure when patient 2 was excluded averaged plus 1.3 grams. However when compared with the figure of 12 grams of positive nitrogen balance obtained during the period of plasma or blood administration the degree of nitrogen retention induced by plasma and blood was striking. Moreover it would seem that there was little, if any latent increased nitrogen excretion at least for such periods as were studied here. The negative

TABLE IV—BLOOD AND CELL VOLUME CHANGES IN A PATIENT WHO RECEIVED TEN TRANSFUSIONS OVER AN ELEVEN DAY PERIOD—PATIENT 5 NO 135688

Day	Total cir- culating plasma protein in grams	Total cir- culating hemoglobin in grams	Plasma volume in cc.	Blood volume in cc.	Hemo- crit reading	Amount blood given daily in cc.
	75	275	570	2150	38	600
	75	210	55	2500	30	900
3	73.8	253	1403	2300	39	500
4	78.8	207.6	1464	2400	30	200
5						200
6						1200
7	90	325	500	2500	40	
8						600
9	64.5	518	518	3300	54	500
10						600
11						150
12	86	545	1370	3000	57	
6	127	560	785	3500	40	

or low positive balance figures which occurred in the post transfusion period were largely due to the fact that the oral nitrogen intake in patient 2 was zero. However patients 3, 4 and 5 were ingesting sufficient oral nitrogen to give them a positive nitrogen balance.

Of some interest is the continued plasma protein decline in patient 1 during amigen administration. The plasma protein concentration fell from 5.7 to 4.8 grams per cent in spite of a total nitrogen intake of 13.0 grams per day during this period although the total circulating plasma protein level was only reduced from 177 grams to 163 grams. A daily positive nitrogen balance of 1.7 grams was maintained in contrast to the 9.9 and 6.8 grams daily positive nitrogen balance during the 2 periods of plasma therapy (Table I patient 1 periods 1 and 6). Patient 8 showed a similar failure of amigen to maintain the plasma protein concentrations in the quantities administered. The normal plasma protein concentrations in both of these patients were again elevated when plasma and blood were given. In patient 1 where balance studies were made, there was only a 1.7 positive nitrogen balance during the period of amigen

TABLE V

Patient	Total circulating hemoglobin in grams		Hemoglobin—grams per cent		Total circulating plasma proteins in grams		Total circulating blood proteins in grams	
	Before plasma transfusion	After plasma transfusion	Before plasma transfusion	After plasma transfusion	Before plasma transfusion	After plasma transfusion	Before plasma transfusion	After plasma transfusion
S M No 40757	450	428	3.4	10.7	57	82	694	728
E R No 306635	558	874.8	3.4	8	230	355	1,468	1,498
J L S No 40143	550	540	6	8	5	245	875	890
M L No 401977	300	546	13	7	95		540	840
J L S No 35668 Received blood only	578.4	546	6	8	78 Blood trans only	91	403	771
M V No 400774	777.6	754	14.4	13	142	79	1093	1076

administration. These findings are in agreement with Elman (2) and Meyer and associates (2) in so far as they found that patients could be maintained in positive nitrogen with amigen. However it was very difficult to elevate the plasma protein concentration at all even though large quantities of amigen were given (2,000 to 3,000 per day).

Data on the 6 patients on whom nitrogen balance studies and plasma volume measurements were made indicate that most of the transfused plasma could not be accounted for on the basis of increases in the total circulating plasma proteins. This point has been emphasized by Whipple and associates (9) and Elman (2) who found that only about 10 per cent of transfused plasma could be accounted for on the basis of an increased total circulating plasma proteins in dogs 1 week after the plasma administration. Our data suggest that man in the hypoproteinemic state reacts in a similar manner and that the larger amount of the administered plasma remained unaccounted for. It is possible as Whipple suggests that most of the transfused plasma proteins were recast as tissue protein without appreciable nitrogen loss.

An unexpected finding is that revealed by patient 5 who had generalized edema. This patient was given 5,200 cubic centimeters of whole blood over a 6 day period before there was an appreciable increase in total circulating blood or in plasma protein concentration, and

during this time the hematocrit reading was not increased even though a quantity equal to twice the patient's calculated blood volume was administered as transfused whole blood. During this same time the frequent calculations of the patient's blood volume failed to show an appreciable change from the initial pretransfusion level. However as these transfusions were continued, there was a rapid rise in the hematocrit reading in the total circulating plasma and blood proteins and in the total blood volume (see Tables III and IV). Weight loss, a disappearance of ankle edema, and a marked diuresis began after the third day of transfusions. The apparent failure of the patient's blood response to the transfusions of the first 6 days was not characterized by increased nitrogen loss, since there was a daily 20 grams positive nitrogen balance during this period. This figure fell to 4 grams positive balance during the 9 day study period which followed the transfusions. The oral nitrogen intakes were similar for both periods. Just what was the fate of the 5,200 cubic centimeters cannot be established from these data. The postoperative period was moderately septic for 7 days and there was a moderate discharge from the wound. Since there was no great increase in nitrogen excretion and since the transfused blood could not be accounted for by changes in blood protein, hematocrit reading or blood volume, some of it may have been held extravascularly possi-

bly as tissue protein. The amount of daily nitrogen lost through the wound ranged from 0.1 gram to 1.0 gram and did not appear to account for a major portion of the transfused protein.

States of anemia probably should also be considered as states of hypoproteinemia much in the same way that the plasma hypoproteinemic states are recognized. Whereas we corrected the plasma hypoproteinemia in our patients, there was always some degree of anemia which persisted unless blood was also given. A more complete picture would probably be obtained if the whole blood protein concentrations were considered in addition to the plasma protein concentrations. The hemoglobin concentration of 15 to 16 grams per cent in the normal person plus 6.5 to 7.5 grams per cent for plasma gives a total of 22 to 24 grams per cent for the total blood protein concentration. Since hemoglobin constitutes approximately two-thirds of the blood protein, a marked anemia may give a striking reduction in the whole blood protein even though the plasma protein is normal. The term hypoproteinemia probably should not be limited to lowered plasma proteins, but should apply to deficits in hemoglobin as well. Where anemia and hypoproteinemia coexist, both blood and plasma are necessary to restore the blood protein concentration to normal.

Plasma transfusions appear to induce an anemia out of proportion to that which might be accounted for by plasma dilution. The degree of this anemia, the total circulating hemoglobin and the grams per cent of hemoglobin before and at the end of the periods of plasma transfusions are shown in Table V. While the grams per cent of hemoglobin were appreciably decreased in most cases, the total circulating hemoglobin indicated that some of this anemia was due to blood volume changes.

The retarded recognition of the value of plasma for the purpose of elevating the plasma proteins may be attributed to the fact that most have used quantities of plasma too small to give appreciable changes (2, 14) in the plasma protein concentration. Our findings suggest that any less than 2500 cubic centimeters of plasma given over a period of 48

hours or longer is not likely to elevate the plasma protein concentration in the hypoproteinemic patient. Furthermore, our patients showed that an increase in the plasma volume occurred before the plasma protein concentration was increased and that the total circulating plasma proteins were often increased before the plasma protein concentration was elevated. For this reason several liters of plasma or blood may have to be injected before any elevation in the plasma protein concentration can be detected. During this early period most of the transfused protein including some hemoglobin, probably leaves the blood stream and possibly is converted into body protein as Whipple (14) has suggested. It is only after the plasma volume has been restored and the tissue proteins partially restored that the plasma protein concentration begins to rise.

SUMMARY

1 Plasma and blood were administered to a series of 9 surgical patients who had previously developed various degrees of hypoproteinemia and anemia.

2 The amounts of plasma usually given daily were large as measured by current practice but the amount of nitrogen given by this method was less than that advocated when protein hydrolysates are used for this purpose.

3 The increase in the plasma protein concentration was rapid after these quantities of plasma and blood were given and normal values were usually established within 5 to 7 days.

4 Nitrogen balance studies and plasma volume changes were made on 6 of these patients and showed that most of the transfused plasma probably left the blood stream within a day or two. That which could not be accounted for on the basis of an increase of total circulating plasma protein may possibly have been recast as tissue protein since there was little, if any evidence of a latent increased nitrogen excretion. The possibility that small increases of nitrogen excretion over a prolonged period of time may have occurred has not been detected in this study.

5 Larger amounts of plasma and blood were required to elevate the plasma protein

concentration in the more severely starved patient than in the better nourished one even though the plasma protein concentrations were reduced to similar levels in both groups.

6 Blood transfusions alone were administered daily with one exception for 11 days to 1 patient and as in the case of patients receiving plasma, the plasma protein concentration was restored to normal without evidence of latent nitrogen loss.

7 This work suggests that the fear of overtransfusion is unwarranted except where the cardiovascular reserve is reduced. It also emphasizes the importance of great enlargement of facilities for obtaining blood and plasma and the wisdom of using blood in some patients in place of plasma because of the gain in oxygen-carrying cells and the possible utilization of hemoglobin to form tissue proteins.

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THE ELECTROCARDIOGRAM IN BILIARY TRACT DISEASE AND DURING EXPERIMENTAL BILIARY DISTENTION

Clinical Observations on 26 Patients

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THE relationship and coexistence of biliary tract and heart disease have been of interest for many years. Data revealing a statistically significant coexistence of these two conditions are reported in the literature (Willius and Brown Breyfogle Laird Schwartz and Herman Walsh Bland, Taquini, and White and Tennant and Zimmerman) There is, however no conclusive evidence that the diseased gall bladder may cause heart disease Many physiopathological factors such as age, disturbed metabolism obesity diet and infection are common to both

Electrocardiographic changes in gall bladder disease have been reported by Fitz Hugh and Wolferth Clarke Breitwieser and Wakefield The abnormalities noted were T wave changes in significant leads, slurring and notching of the QRS complexes and elevation or depression of the RS-T segments Following gall bladder surgery improvement of the electrocardiogram or return to normal has been reported. However, it should be pointed out that electrocardiographic changes have been described in other intra abdominal conditions such as pancreatitis perforated peptic ulcer mesenteric thrombosis hemorrhage gastric distention and esophageal hiatus hernia (Gubner Murphy and Livezey Scherf and Klotz Gottesman Casten and Beller Morrison and Swalm and Gilbert, 5)

The electrocardiographic changes in biliary tract disease may be a result of viscerocardiac reflexes. Gilbert, Fenn and LeRoy (6) have demonstrated a reduction in coronary blood flow following stimulation of abdominal vis-

cera in animals. In patients with angina pectoris they were able to precipitate anginal attacks by distention of the stomach. Electrocardiograms taken simultaneously revealed abnormalities

Zollinger distended the gall bladder and common duct in 6 patients and studied visceral and referred pain In no patient did the pain simulate that of angina pectoris Ravdin Royster and Sanders distended the common bile duct in 2 patients in whom they were able to produce anginal pain Pain disappeared following release of pressure They reported that electrocardiograms taken during distention were negative

Hodge Messer and Hill distended the gall bladder of normal dogs. No significant changes in the electrocardiogram occurred other than an increase in the cardiac rate. However in animals with experimentally produced lesions of the coronary arteries significant abnormalities of the RS-T segments of the electrocardiogram occurred consistently

Since the relationship of biliary tract and heart disease is not clearly established this study was undertaken Electrocardiographic studies were made on 26 patients undergoing surgery of the biliary tract In 13 of the patients observations on pain respirations and blood pressure were made

METHOD OF STUDY

Routine electrocardiograms were obtained before and after operation on each patient. When abnormalities were encountered serial electrocardiograms with precordial leads of the C V series were obtained Electrocardiograms were taken during experimental biliary distention

Experimental distention of the biliary tract was produced in all patients Sterile normal

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TABLE I—ELECTROCARDIOGRAPH FINDINGS IN GALL-BLADDER DISTENTION DURING OPERATION

Case No.	Age	Sex	Control		After anesthesia		During distention		After release of press.	
			Rate	EKG findings	Rate	EKG changes	Rate	EKG changes	Rate	EKG changes
C W		Female		Flat to low upright T, low upright T and J	66	T and normal upright, T ₃ flat	86	Ectopical rhythm as lead I. No other change	74	Normal rhythm, T wave upright
B W		Female	74	Normal record	64	N change	60	No change	48	No change
M S		Female	83	T borderline in amplitude	68	N change	74	T slightly more upright	71	T slightly less upright
M S	47	Female	8	Normal record	80	Irregular rhythm N other changes	81	Myocardial rhythm still present. No change	86	Normal rhythm. Premature ventricular contractions less frequent
R B	3	Male	64	Normal record	93	N change	98	A single premature contraction. No other change	8	No change
O S	35	Female	100	T ₁ upright, slight depression ST ₁ , T ₃ inverted	123	Depression ST ₁ , T less upright, T ₃ flat	135	No change	140	No change
M M	32	Female	86	Normal record	70	Normal rhythm, T less upright, T diphasic	74	N change	75	No change
N S	47	Female	48	T borderline in amplitude	90	Ectopical rhythm N other changes	90	Ectopical rhythm still present. No other change	74	T now usually upright. Normal rhythm present
M X	30	Female	86	Left axis deviation T wave normal	83	T low upright, left axis deviation	98	No change	103	One premature ventricular contraction. No other change
H H	39	Female	76	Normal record	70	No change	7	N change	53	No change
N B		Female	75	Left axis deviation	84	Stems arrhythmia N other changes	94	Premature ventricular contractions some with stems arrhythmia	84	Premature ventricular contractions less frequent stems arrhythmia still present
N H	45	Female	64	Left axis deviation	64	No change	61	N change	66	No change
X A	35	Female	7	Normal record	9	No change	64	T less upright	73	T wave usually upright
R F	35	Female	98	Flat T, low upright T and T ₃ Left axis deviation	79	Slight inversion of T. Axis deviation decreased	75	Stems arrhythmia No other change	68	T now low upright. T slightly more upright. No other change

saline solution was introduced under pressure through a cannula in the gall bladder or a rubber T tube in the common bile duct. Pressure was controlled by a water manometer apparatus and the maximum pressure used was 100 centimeters of water.

All of the patients had biliary tract disease. Twenty two had chronic cholecystitis with cholelithiasis. Three patients previously had had cholecystectomy for gall bladder disease with stones. At operation 1 had common duct calculi and in the remaining 2 no definite cause for their symptoms was found. Another

patient had a carcinoma of the head of the pancreas associated with chronic cholecystitis and cholelithiasis.

In the first group in which there were 14 patients with chronic cholecystitis and cholelithiasis gall bladder distention and electrocardiographic studies were carried out simultaneously at operation. All had the preoperative medication of morphine and hyoscine. Light ethylene-curare anesthesia was employed in each. Supplementary ether or cyclopropane was used occasionally but not during distention and electrocardiography. Control

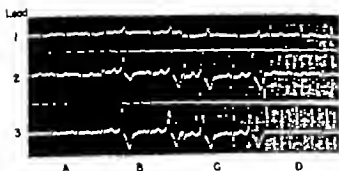


Fig. 1. Case 8. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.

electrocardiograms were taken before anesthesia after anesthesia before distention of the gall bladder during distention of the gall bladder, 10 minutes after distention and several days following operation.

In the second group of 13 patients distention of the common bile duct was carried out in 12 patients and the gall bladder in 1. Distention was performed 10 or more days after operation without medication or anesthesia. One patient in this group (Case 22) is also included in group 1 (Case 14). Observations were made on pain respiration and blood pressure. Electrocardiograms were taken before distention, with distention, and 10 minutes after distention. All had one or more preoperative and postoperative electrocardiograms.

RESULTS

The effects of anesthesia and distention of the gall bladder on the cardiac rate and electrocardiogram in group 1 are summarized in Table I. In 9 patients there was a decrease in cardiac rate after anesthesia and an increase in 5. During experimental distention of the gall bladder the cardiac rate increased in 10 patients and decreased in 1. There was no change in 3. Following release of pressure in the gall bladder 8 patients had a decrease in cardiac rate and 6 an increase.

After anesthesia premature ventricular contractions occurred in 2 cases (4 and 8) causing bigeminal rhythm (Fig. 1). This disappeared following cholecystectomy. One patient developed nodal rhythm which persisted during the operation (Fig. 2).

Three patients developed premature ventricular contractions during gall bladder dis-

tention, but this disappeared after release of pressure (Fig. 3). There were no cases in group 1 in which the P R interval or the QRS conduction time were prolonged during anesthesia or during gall bladder distention.

Electrocardiograms taken before anesthesia and after the preoperative medication of morphine and hyoscine revealed that 4 of the patients (Cases 1, 3, 8, and 14) in group 1 had records which were borderline or slightly abnormal due to depression of T 1. Three of these cases had normal electrocardiograms before the preoperative medication and 1 was abnormal. The electrocardiogram in 1 became normal after anesthesia (Fig. 3) and in 2 the records returned to normal following operation.

Four patients (Cases 6, 7, 9, and 14) developed significant T wave changes in lead I with anesthesia. Case 6 showed depression of the RS-T segment as well as the T wave in lead I suggesting myocardial ischemia (Fig. 4). In Cases 7 and 9 there was depression of T 1 and in Case 14 T 1 became slightly inverted.

During gall bladder distention the T waves in lead I were slightly depressed in Case 13 (Fig. 5) and slightly more upright in Case 3.

The results of biliary distention 10 or more days after operation in 13 patients are summarized in Table II. Eleven patients showed an increase in the cardiac rate during distention of the biliary tract while 2 showed a slight decrease. Premature ventricular contractions developed in 1 patient during distention of the common duct and in 1 patient a single premature auricular contraction occurred after release of pressure. There were no cases in group 2 in which the P R interval or the QRS conduction time were prolonged during distention. There were 2 cases (15 and 19) with abnormal electrocardiograms before distention.



Fig. 2. Case 7. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.



Fig. 3. Case 1. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.



Fig. 4. Case 6. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.

of the common duct. In Case 15 T₁ changed from diphasic to low upright during distention (Fig 6). Case 19 showed no change. In 1 case with a normal record the T wave in lead I was slightly depressed during distention (Fig 7).

During distention of the common bile duct or gall bladder 11 of the 13 patients experienced pain. The 2 that did not experience pain had celiac ganglionectomy performed for biliary dyskinesia (Grimson Hesser Kitchen). One of these experienced only vague discomfort in the left upper abdominal quadrant.

In those having pain it was described as being severe and oppressive in character and located in the epigastrium. Four patients also complained of pain in the right upper abdominal quadrant and in 1 case there was radiation

of pain straight through from the epigastrium into the back. In no patient did the pain simulate that of angina pectoris. During distention and soon following distention 6 patients noted nausea and 2 patients vomited.

All patients who complained of pain during distention developed respiratory distress characterized by inspiratory inhibition. On release of pressure this symptom immediately subsided.

In 10 patients there was a rise in blood pressure during distention and a slight drop in 3.

In 5 of the patients interesting electrocardiographic changes occurred before and after operation.

CASE REPORTS

CASE 1. C. W., a 41 year old white female, was admitted to Duke Hospital on January 7, 1947 with chronic cholecystitis and cholelithiasis. She had typical symptoms of recurrent biliary colic, nausea, and vomiting of 1½ years duration. The only cardiac symptom that could be elicited was that of slight palpitation during attacks of biliary colic. There was nothing to suggest the anginal syndrome, and there was no history of digitalis or use of any medication prior to hospitalization. On physical examination the blood pressure was 120/80. She was of asthenic build and there was no jaundice. The heart and lungs were normal. Abdominal examination revealed only slight right upper quadrant tenderness. The heart was not shown to be enlarged by x ray examination. An electrocardiogram taken on

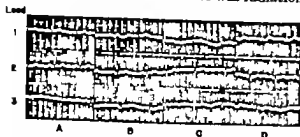


Fig. 5. Case 3. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.

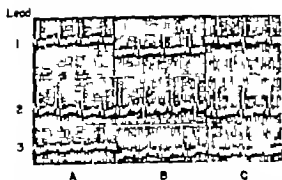


Fig. 6. Case 15. A, Before common bile duct distention. B, During distention. C, Ten minutes following distention.

the date of admission was distinctly abnormal (Fig. 8). Serial records on January 10, 14, and 17 showed a progressive return to normal. Cholecystectomy was performed on January 22 under ethylene-chlorure oxygen anesthesia with supplemental cyclopropane and ether. Electrocardiograms taken during operation are shown in Figure 3. Following operation the electrocardiogram taken on January 23 and on February 2 became abnormal due to inversion of T₁. This was not significantly changed by exercise or

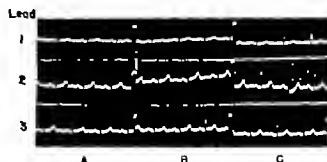


Fig. 7. Case 24. A, Before common bile duct distention. B, During distention. C, Ten minutes following distention.

breathing pure oxygen for 5 minutes. A follow up electrocardiogram 6 months later was normal (Fig. 8).

CASE 6 O. E. S. a 55 year old white female was admitted to Duke Hospital on February 20, 1947 because of bilateral thrombophlebitis of the lower extremities of about 3 weeks duration. There was a history of intolerance to fatty foods with epigastric distress after meals of 4 months' duration. There was no history of precordial or substernal pain or exertional dyspnea. She had been given digitoxin before admission to the hospital because of edema of the lower extremities. On physical examination the

TABLE II.—ELECTROCARDIOGRAPH FINDINGS IN COMMON DUCT OR GALL BLADDER DISTENTION IN 13 UNANESTHETIZED PATIENTS

Case No.	Age	Sex	Control		During distention		After release of pressure	
			Rate	EKG findings	Rate	EKG changes	Rate	EKG changes
E. G.	62	Female	70	Slight depression of ST, diphasic T ₁ . Slight depression of ST	83	Less depression of ST, low upright T slightly more depression of ST	90	Premature arricular contractions present. T less diphasic
G. L. B.	53	Female	95	Left axis deviation	91	N change	101	N change
M. P.	44	Female	91	Normal record	110	N change	98	No change
R. C. A.	69	Male	84	Normal record	95	No change	87	No change
S. H.	34	Female	106	Low upright T ₁ , diphasic T ₂ & T ₃ T ₄ low upright	105	N change	100	No change
M. J.	63	Female	8	Premature ventricular contractions	72	Premature ventricular contractions. T more upright	70	Premature ventricular contractions still present. No other change
M. D.	35	Female	80	Normal record	90	No change	80	N change
R. F.	51	Female	100	Left axis deviation. T waves normal	10	No change	04	N change
L. H.	57	Female	98	Normal record	95	N change	83	N change
M. M.	48	Male	8	Normal record	84	T slightly less upright	8	T waves normally upright
O. A.	35	Female	04	Normal record	106	N change	106	No change
O. M.	1	Female	5	Normal record	13	No change	10	No change
F. K.	37	Female	9	Premature ventricular contractions	100	No change	96	No change

*Included in Table I as case 4.

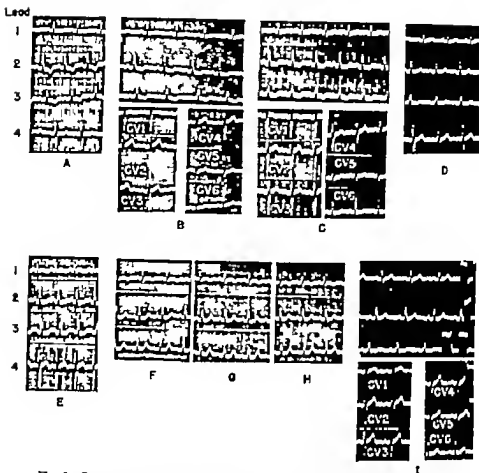


Fig. 8. Case 13. A, Electrocardiogram taken on day of admission to hospital (January 7, 1947). B, Record on 3rd hospital day. C, Record on 7th hospital day. D, Record on 10th hospital day. E, Record taken on 1st postoperative day (January 23, 1947). F, Taken on 15th postoperative day before exercise. G, Taken on 17th postoperative day after exercise. H, Taken on 18th postoperative day after breathing 100 per cent oxygen for 5 minutes. I, Record 6 months after operation (July 3, 1947).

blood pressure was 130/80. The patient was obese and there was no icterus. The heart and lungs were not remarkable. The liver was enlarged and there was slight tenderness in the right upper quadrant. There was a subsiding bilateral deep thrombophlebitis of the legs. X-ray examination did not show enlargement of the heart. Serial preoperative electrocardiograms are shown in Figure 9. She received no digitalis during the first 16 days of hospitalization but was digitalized on March 8. An electrocardiogram on March 17 while on a maintenance dose of digitalis, showed evidence of return to normal. Cholecystectomy for chronic cholecystitis with cholelithiasis was carried out on March 19. The postoperative electrocardiograms gradually returned to normal and a record with extra precordial leads 436 months later was normal (Fig. 9).

CASE 14. R. E. F., a 55 year old white female, was admitted to Duke Hospital on April 15, 1947 because of pyrexia of unknown origin. There was no history of precordial or substernal pain or diminished car-

diac reserve. She gave a history of vague aching pain of the joints of all extremities and back as well as generalized aching of her muscles of about 18 months duration and bouts of recurrent low-grade fever for 12 months. On physical examination the blood pressure was 140/90. She was obese and there was no jaundice. There was some lordosis of the lumbar spine and pain on motion of both shoulders. Examination of the heart revealed slight acceleration of the aortic second sound and there was a soft systolic murmur at the apex. The abdominal examination revealed slight right upper quadrant tenderness. She had an inguinal hernia on the right. X-ray examination revealed the heart to be at the upper limits of normal in size and the spine showed osteoarthritic changes. A gall bladder visualization test revealed a nonfunctioning gall bladder. Preoperative electrocardiograms are shown in Figure 10. On April 30 a right inguinal herniorrhaphy, cholecystectomy, choledochotomy and choledochostomy were done under ethylene-chloride-ether anesthesia. The

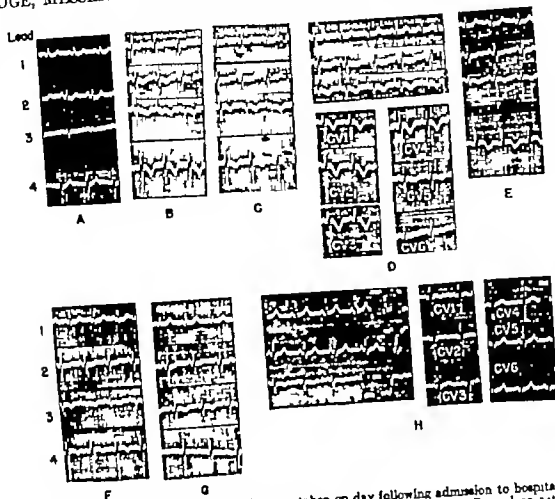


Fig 9. Case 6. A Electrocardiogram taken on day following admission to hospital. B Record on 8th hospital day. C Record on 12th hospital day. D Record on 14th hospital day. E, Record taken on 15th hospital day and 9 days after complete digitalization. F Electrocardiogram on 3rd day following cholecystectomy. G Record on 8th postoperative day. H Record taken 4½ months later.

gall bladder showed chronic cholecystitis with cholelithiasis. Electrocardiograms taken during operation are shown in Figure 11. On May 13 distention of the common bile duct was carried out with electrocardiographic studies (Fig 12). An electrocardiogram taken 13 days postoperatively shows a return to the normal of the T waves in the limb leads (Fig 10).

CASE 15. E. R. G., a 69 year old white female was admitted to Duke Hospital on January 20 1947 because of colicky right upper quadrant pain of 18 months duration. A previous cholecystectomy had been performed in July 1946. She had been a known hypertensive for at least 4 years and had noted mild exertional dyspnea for 2 years and palpitation for 18 months. There had been no ankle edema and she had taken no digitals recently. On physical examination the blood pressure was recorded as 155/110. The patient was obese and slightly jaundiced with a blood bilirubin of 2.8 milligrams per 100 cubic centimeters. On January 28 1947 choledochotomy was carried out for calculi and 10 days postoperatively distention of the common bile duct was per-

formed. Electrocardiograms taken before and after operation are shown in Figure 13. An electrocardiogram taken 5 months after operation showed normal T waves in the limb leads with only slight flattening of the T waves in CV 5 and CV 6 in the precordial leads.

CASE 19. S. E. B. a 34 year old white female, was admitted to Duke Hospital on March 12 1947 because of nausea, vomiting and gaseous distention of 3 months duration. She had a cholecystectomy 11 years prior to admission. She had experienced mild recurrent attacks of bronchial asthma for 23 years. There were no symptoms of cardiac disease, and no recent use of digitals. On physical examination the blood pressure was 140/80. She was slightly obese and icteric. The heart was normal on physical examination and x ray examination showed no enlargement. On March 20 1947 exploratory laparotomy was carried out with lysis of adhesions. The common bile duct was explored. No stones were found. However a stenosis at the ampulla was dilated. On the fourteenth postoperative day the common bile duct was distended with simultaneous electrocardiography. The preoperative and postoperative electro-

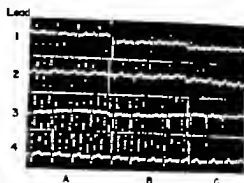
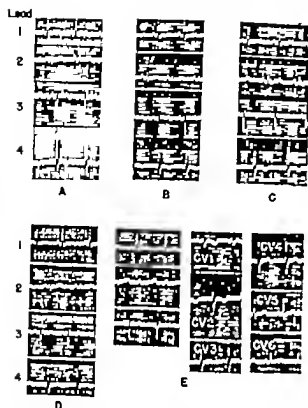


Fig. 2. Case 3. A, Before common bile duct distention. B, During distention. C, Ten minutes following distention.

Fig. 1. Cases 4 and 5. A, Electrocardiogram taken on day following admission to hospital. B, Record on 6th hospital day. C, Record on 7th hospital day. D, Record taken 8 days following cholecystectomy and choledochostomy. E, Record on 13th postoperative day.

cardiograms are shown in Figure 14. There was no change in the electrocardiogram during common duct distention other than an increase in cardiac rate.

DISCUSSION

It is evident from this study that several factors may affect the electrocardiogram. Depression of the T wave in lead I was observed in 3 cases (1, 3 and 8) after the preoperative medication of morphine and hyoscine. The

T wave changes in Case 1 may be related to the marked instability of the electrocardiogram exhibited during the entire period of hospitalization. In Case 3 the changes were of such slight degree that they could not be considered of significance. The T wave became upright in Case 8 at the end of operation.

Although T wave changes occurred in 4 patients following anesthesia, in only 1 (Case 6) did RS-T segment depression occur suggesting myocardial ischemia.

The slight depression of T_r during biliary distention in Cases 13 and 24 were of minor degree and are considered insignificant. The increase of amplitude of the T waves in lead I during distention was striking only in Case 15. Therefore, it is obvious that the electrocardiographic pattern is not predictable in biliary distention.

The electrocardiographic changes observed in 5 of the cases (1, 6, 14, 15 and 19) during the preoperative and postoperative period are not clear. The T wave changes recorded are similar to those observed by Fitz Hugh and Wolferth, Clarke and Brietwieser although

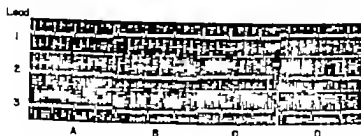


Fig. 3. Case 4. A, Control record taken before anesthesia. B, After anesthesia. C, During gall-bladder distention. D, Following cholecystectomy.

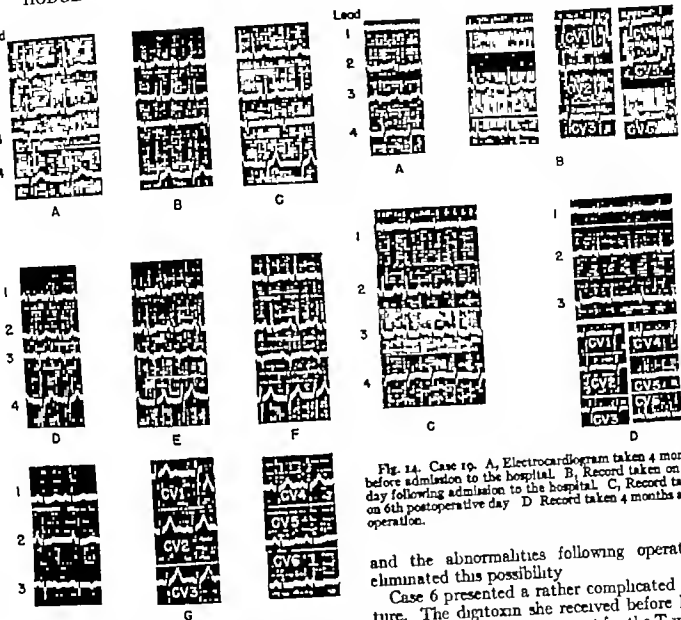


Fig. 13. Case 15. A, Electrocardiogram taken 8 months before admission to the hospital. B, Record taken on admission to the hospital (January 20, 1947). C, Record on 3rd hospital day. D, Record taken on 7th day following cholecystectomy. E, Record on 10th postoperative day. F, Record on 13th postoperative day. G, Record taken 5 months after operation.

the majority of the patients reported by these authors were thought to have coronary artery disease. In none of the 5 cases reported here was there a history of the anginal syndrome, myocardial infarction or heart failure. The electrocardiogram did not show changes suggestive of myocardial infarction.

The T wave changes in Case 1 initially suggested digitalis effect, however this was not confirmed by history. The rapid return of the electrocardiogram to normal before operation

Fig. 14. Case 19. A, Electrocardiogram taken 4 months before admission to the hospital. B, Record taken on the day following admission to the hospital. C, Record taken on 6th postoperative day. D, Record taken 4 months after operation.

and the abnormalities following operation eliminated this possibility.

Case 6 presented a rather complicated picture. The digitalis she received before hospitalization can hardly account for the T wave changes observed during the first 2 weeks. After complete digitalization on the sixteenth hospital day the record appeared more normal.

Although there was a history of a low grade fever in Case 14 this was never higher than 38.2 degrees centigrade before operation. Later she became afebrile. This could hardly explain the electrocardiographic changes.

In Case 15 the electrocardiographic findings in lead I on the tenth postoperative day suggested left ventricular strain. However it is unlikely that hypertension could cause this abnormality to occur and disappear in 6 days. It is of interest that during distention of the common bile duct on the tenth postoperative day T₁ changed from diphasic to upright.

It is apparent that serial electrocardiograms are of the utmost importance when electrocardiographic changes are used as a criteria of cardiac improvement following gall-bladder surgery. Single records are of doubtful value since we have observed abnormal electrocardiograms to return to normal before operation and normal records to become abnormal after operation. There are no adequate electrocardiographic studies on the variations of the electrocardiogram in a large series of normal individuals. It is obvious that these electrocardiographic findings mirror changes in the myocardium however the nature of these is not clear. We do not feel that a diagnosis of coronary artery disease or myocardial infarction could be made on any of the above patients from the information obtained from history and physical examination.

SUMMARY AND CONCLUSIONS

In 26 patients with biliary tract disease the gall bladder or common bile duct was experimentally distended and electrocardiographic studies were made. The gall bladder was distended at operation in 14 patients and the common bile duct was distended in 12 patients and the gall bladder in 1 during the postoperative period. Disturbances in rate rhythm and the T waves are reported. The changes observed in the electrocardiograms during biliary distention in patients without clinical coronary artery disease were insignificant. This finding is similar to our previous observations on normal dogs (10). The effect of biliary distention on patients with the anginal syndrome remains to be investigated. Five of the patients showed changing electrocardiograms during the preoperative and postoperative periods. In no patient was the diagnosis of angina pectoris or myocardial infarction made and in no case did common bile duct or gall bladder distention cause anginal pain. Pain was more or less characteristic of that caused by biliary disease. All patients experiencing pain during common duct or gall bladder distention complained of respiratory

distress and in the majority there was a rise in blood pressure.

There is no definite electrocardiographic pattern in gall bladder disease. Changes in the electrocardiogram are variable and may be coincidental. Distention of the gall bladder or common bile duct may cause minor disturbances in rate and rhythm. T wave changes of a minor degree were observed but in no instance did these changes suggest a coronary pattern.

Conclusions regarding improvement in the cardiac status of patients following gall-bladder surgery are not justified on the basis of a single preoperative and postoperative electrocardiogram since serial records may show instability of the T waves.

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EDITORIALS

SURGERY Gynecology and Obstetrics

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GENERAL PLASTIC SURGERY

GENERAL plastic or reconstructive surgery has received varied recognition among surgeons. It may occupy an established position and an independent service in one medical organization while in another work that would fall into its category may be dispersed over several services depending upon the anatomical field into which the various lesions fall. But there is evidence that a plastic surgery department may relieve other services to a worthwhile extent.

To such a service would go patients falling into these groups (1) Injuries and deformities of the face and jaws that may alter the shape of the bony structure, or leave disfiguring scars of the soft tissue or result in abnormal function and physiology. These lesions include the work loosely called maxillofacial surgery (2) Injuries and deformities of any part of the body that require skin grafts or flaps, scar adjustments or surface tissue re-

adjustment. (3) Serious burns which may not be regarded initially as requiring ultimate restoration of surface but which are apt to do so and which from the start might be benefited by the opinion and care of a plastic surgeon.

Surgeons who work in an established field of general plastic surgery must necessarily rely on help from those trained in special anatomical fields such as nose and throat, eye, genitourinary, orthopedic and neurological surgery, and dentistry. In other words, the individual patient is the real consideration and whatever is best for him is the goal.

On the other hand, there are those who advocate that plastic surgery in a certain anatomical field such as nose and throat, eye, dentistry and orthopedics, should be done by specialists in this field. In some instances this method of care has produced excellent plastic surgeons in limited fields but there is a tendency for these surgeons to reach out into general plastic surgery and most surgical groups prefer to have their associates trained on general plastic services.

General plastic surgical services are comparable to general surgical services in affording groundwork training. Although often thought of as working in a limited field, the general plastic surgeon may do more different operations than other surgeons. It is noteworthy that practically all general surgeons are established as leaders because of work in some one field such as the thorax, heart, abdomen, tumor work or clinical research.

If progress is to be made, the plastic surgeon can never get away from the necessity of following and utilizing the results of research in pathology, physiology, chemistry, genetics, neuropsychiatry, etc. He utilizes general basic

advancements in the care and protection of patients undergoing surgery while he himself may have time for investigation only in his own field. However he can still be a pioneer or frontiersman in ferreting out simplification and directness in his general problems and in perfecting the technical skill that is so essential if patients are to have the greatest benefit. His co-operation with other services and other specialties based on anatomical grounds is one of his best contributions. The evident fact that deep healing can be no better than the surface healing has led the way for very close working relationship of the neurosurgeon and orthopedic surgeon with the plastic surgeon and because of plastic methods of preparing and repairing wounds many lives have been saved and much function restored, especially in the military services.

The military influence on plastic surgery has been great. Modern plastic surgery received its start in the last war and what was learned then was transferred to civilian use. During the intervening twenty five years, great strides were made so that the tables were reversed in World War II in that this civilian-gained knowledge could be turned back to the service for immediate use.

Within the United States Army and Navy during the recent war were built the largest plastic surgery services in the history of surgery and again young civilian surgeons gained knowledge in the services that can be given back to civilians. Before the war however the basis and possibilities of work had been established and the younger surgeons could go ahead under the guidance of civilian surgeons in the services.

A single item of interest in the change in plastic surgery from one war to another is the use of free skin grafts. In a three hundred page report from the last war no mention was made of skin grafts except as a part of one

sentence. Neither was any mention made of burns. In the recent war about one-third of the work in plastic surgery was with free skin grafts and about one-third for patients with burns. As one pioneer in plastic surgery resident in another country said, 'The things that are routine procedures in this war would have been considered fantastic in the last one.'

Much plastic surgery had been predicted on the repair of defects resulting from cancer, but the older patients with lax tissue available for repair do not present quite the same problem as the eighteen to twenty five year old youth who has had his face blown away in a second with destruction of features that he has developed for many years and counted on to carry him through life. These young patients deserve having the minimal of additional scarring and having repairs that would give the least possible residual deformity. They were forthright in their sacrifices and were humble in their demands—a challenge that was the best impetus to try to approach giving them what they deserved even though the surgeon realized his limitations in doing so. The annals of surgery display no greater courage and will to live on the part of the patients, or work and hope on the part of the surgeon than is found in the recent war in the doctor patient relationship and endeavor as seen in the blasted and burned and crushed patients and in their surgeons.

In this field of surgery it is difficult to get away from the doctor patient relationship. The demands of the patient through a long series of operations will not allow it in the first place, the clinical results cannot be good without it in the second place and there is some intangible feeling of the surgeon for his work that does not allow widespread mass production of the important details of repair. This might be called individual artistry but the results are so far short of artistry that the sur-

geon does not like to be stigmatized with it, or thought of as being able to make things perfect. He aims at function first, and with this goes a plan and effort to restore contour and smoothness to as near normal as possible.

Mass production does have to be done when hospitals are flooded with battle casualties or massive civilian catastrophes, but this involves mainly life saving measures, such as early grafting of burns. No matter how great the number of patients a nation has to deal with from the fallen soldier on the field to the finished product walking out of the plastic surgery center, there is no substitute for individual doctor patient relationship. This can not come from central direction but has to come from the surgeon and without it little success can be expected.

Plastic surgery has grown up and the field is enlarging. In this growth new ideas come from fields little known and some worn out edicts have been slowly abandoned. One school will use only local tissue another will advocate massive procedures for small defects. The young plastic surgeon will soon realize that he is only making substitutions for losses. He will learn early to use every bit of local tissue available, but he will also learn not to sacrifice adjacent features or function or nerve supply to avoid bringing in new tissue. It is one thing to utilize local tissue but the final *sine qua non* of a plastic surgeon is to be able to add more tissue from a distant part either as a free graft of skin or fascia or cartilage or bone or as a pedicle flap.

There is great interest among foreign surgeons in methods used by American plastic surgeons. The knowledge and the skill and the methods of plastic surgeons are available to all who show interest and seek advice and instruction so that there can be no just complaint of failure to pass on to others what has been found out by the experienced.

The place which plastic surgery holds is to a large part dependent on the surgeons themselves their teaching their ability to call attention to the problems at hand in short their ability to observe and record. There has been much overenthusiastic publicity of the possibilities of plastic surgery but most of it arises from individuals on the fringe or not even up to the edge, and the whole specialty has suffered. The public and often other doctors may have erroneous impressions of the possibilities and limitations of plastic surgery. On the one hand a patient may be told that the impossible can be accomplished and in no time at all, and thus come deep disappointments. On the other hand the simplest type of operative correction may be negated or omitted and the patient may go for months or years without a relatively simple procedure that would clear up the whole trouble. An example is a patient with ulcers of both legs who had been incapacitated for nine years and during this time no one seemed to think of a free skin graft. In one operation both legs were repaired with free skin grafts and the patient was returned to duty.

Plastic surgery has grown up it needs to grow further to a large extent this can only come from wide understanding but the challenge is to the individual surgeon who is called on to make substitution for deformed or lost normal physiology, and function and anatomy.

JAMES BARRETT BROWN

INDICATIONS FOR SURGICAL OPERATION AS AFFECTED BY CHEMOTHERAPY

THE introduction of such chemotherapeutic agents as the sulfonamides, penicillin and streptomycin into general use has led to the necessity of re-evaluating the place of surgical operation in the treat-

ment of a variety of infections. Conditions which formerly had come to be regarded as requiring surgical procedures of one sort or another for definitive treatment and were promptly referred to the surgeon now in many instances are treated early and late by the internist or general practitioner while antibacterial agents are being administered. In many instances abscesses and other complications of infection can be avoided by the prompt use of such measures supplemented with blood transfusions, anticoagulants and attention to the nutritional requirements of the patient. Furthermore there is no doubt whatsoever that under this treatment many patients with grave invasive infections show dramatic relief of symptoms with return of temperature to normal and restoration of appetite and sense of well-being. Two important and frequently ignored possibilities however must be kept in mind during chemotherapy for an infection. In the first place the infecting organism or mixture of organisms may not respond to antibiotics and valuable time may be lost if the therapy is hopelessly prolonged and in the second place even though symptomatic relief and striking general improvement is obtained nevertheless a mechanical lesion may have developed for which the only satisfactory treatment is surgical operation. In the one instance undue optimism and in the other a false sense of security lead to a delay in definitive surgical operation.

It should be remembered by internist and surgeon alike that it is the mechanical complications of infection which often require surgical operation. These may be pressure phenomena, loss of substance beyond the power of the organ to heal, crippling scar tissue persisting unabsorbable infected sloughs, fixation of a normally mobile or contractile viscus, narrowing of the lumen of a hollow viscus and the accumulation of exudates in body cavi-

ties. Though the infection may clear with chemotherapy obviously such complications will not and failure to appreciate this fact is unquestionably a common error nowadays.

Illustrations of these points come readily to mind. The symptoms of streptococcus or pneumococcus pneumonia with empyema may respond magically to penicillin therapy yet partial collapse of the lung, thickening of pleura and crippling of respiratory mechanism may persist. Unless evacuation of the empyema and re-expansion of the lung, as by early adequate surgical drainage, is effected the patient is not cured even though freed of virulent bacteria. In necrotizing lung abscess treated by penicillin the sputum will often diminish, the fetor subside, appetite return, cough improve and fever disappear. However if cavitation has occurred not only is the patient not cured but he faces the possibility of epithelization of the cavity, hemorrhage, exacerbation and spread of the infection, and involvement of brain or meninges. Not until the lung has healed is the patient well. Similarly the introduction of streptomycin in the treatment of pulmonary tuberculosis has not obviated the need for the usual measures for cavity closure when cavities exist. In chronic osteomyelitis with sequestration, cure is not to be expected without removal of necrotic bone though external evidences of infection may be controlled by chemotherapy. The general manifestations of renal suppuration may respond to chemotherapy but the function of the kidney may have been so badly impaired as to warrant nephrectomy. The pressure phenomena of epidural abscess of spinal canal or cranium may urgently demand surgical relief though the evidences of infection may otherwise have disappeared under vigorous chemotherapy. In femoral thrombophlebitis the infection may yield to penicillin and sulfonamides but the value of vein liga-

tion in the control of pulmonary infarction must still be considered

In that golden day when a specific chemical treatment for cancer is discovered and put into widespread clinical use, it can be predicted that some of the same considerations mentioned above will enter into the responsibilities of the physician. The secondary mechanical effects of the growth may be disabling or even fatal after all the cancer cells have been destroyed. The premium thus would place on early diagnosis and the need for restorative surgical procedures in the later cases are not hard to imagine.

The matter can be summarized with the statement that chemotherapeutic agents frequently will reduce or abolish the general evidence of infection, while a local mechanical problem amenable only to surgical treatment persists. Failure to recognize the distinction between relief of symptoms and restoration of normal function may lead to a serious delay in definitive treatment. JOHN D. STEWART

THE CHALLENGE OF THE SURGICAL FORUM

THE Surgical Forum has come to occupy an important place in the annual program of the Clinical Congress of Surgeons. There is need among surgeons for a program in which emphasis is lent the presentation of original work. A program formulated on this pattern is informative and stimulating.

Such a program representing essentially the fruits of the labors of the most promising young men in American surgical clinics and laboratories is destined to make its influence felt beyond the meeting halls of the Clinical Congress. Programs embodying new techniques correlating interphase specialty knowledge in the process of development including at the same time a perspective of new ap-

proaches to problems in the broad domain of surgery and outlining advances in related medical fields—such programs quicken the interest of participant and audience alike. What greater catalytic stimulus to productivity is there than an enlivened interest? If continued support is lent the Surgical Forum by American surgical clinics there is good reason to believe that the Surgical Forum will constitute an important means of giving directional growth to surgery in this country.

Surgery is making a valiant struggle to throw off the cloak of empiricism which has dominated its activity too long. And nowhere in the world has there been such a keen interest in experimental research as an approach to surgery as here. Moreover it needs to be said that distinguished surgical bodies in this country have been slow to admit young men who have given ample evidence of promise in the laboratory to active membership in such societies until they have demonstrated an equal proficiency in clinical surgery as reflected in the publication of clinical papers. Sterility of ideas and exclusiveness of membership in scientific societies are frequent and bad companions from which association mediocre programs come too frequently.

The American College of Surgeons is probably the largest organized group of surgeons in the world. It is fitting that they should undertake to sponsor participation in surgical programs of active young investigators whose work is frequently responsible in large measure for the improvements we note in surgery from year to year. Some of those young men bid fair to become the surgical leaders of tomorrow.

Man is gregarious. He meets with his fellow man of like interests to share experiences and profit by the exchange. A man who feels himself self sufficient and independent of his colleagues is denying himself the opportunity

for continued growth which association with stimulating colleagues affords. How quickly his work begins to reveal those telling traces of isolation! Attainment however great does not enable men to get on without assistance from helpful colleagues. Any man who has achieved any measure of success owes much to others. Many an idea is enriched by being communicated to another in that other mind the idea may take more definite shape than in the one from which it sprang initially. Oliver Wendell Holmes put it well. "That which was a weed in one intelligence becomes a flower in the other."

It is a stimulating and gratifying experience to come home from a meeting thrilled and exhilarated with the new thoughts and ideas ex-

pressed there and warmed in spirit by congenial good fellowship. Such occasions enrich our lives stirring us to strive to rise above mediocrity.

"Where'er a noble deed is wrought,
Where'er is spoken a noble thought,
Our hearts in glad surprise
To higher levels rise."

It is the professed intent of the Surgical Forum to try to bring before its audience each year the best creative thought and most original achievement in surgery. If the American College of Surgeons can meet that challenge in the broad domain of surgery and its specialties, it will contribute richly to surgery and bring laurels to itself.

OWEN H. WANGENSTEIN

THE SURGEON'S LIBRARY

THE BOOK SHELF

DOCTORS IN ARMOR

LEA A. RIELY, A.M., M.D., F.A.C.P. Oklahoma City, Oklahoma

HISTORY is merely the summation of biographical characters exerting pressure on a parallelogram of forces toward certain ends. These characters are stark individualists whose thinking molds sciences, nations, religions, etc. They are men of force and stamina, not to be swayed by argument or persuasion unless convinced of the falseness of their premises, and even then many are not converted. Were it not for these thinkers and doers, these knights in armor, conditions would be in a stalemate and we would settle down to a state of *laissez faire* complacency, letting progress perish.

Greek medicine was law and gospel during the Middle Ages until a few iconoclasts began to speak out against the then dominant and iron-bound ideas. Soon after Columbus steered his barks for unknown worlds, Martin Luther and John Calvin began to break the shackles of religious dogma, and Paracelsus those of Galenic doctrines. Publicly burning the works of Galen and Avicenna in a bonfire and lecturing in German out of his own experience, Paracelsus issued his polemics, both oral and written, against the then existing beliefs. For this he was driven from one town to another by professional enemies.

Emeritus Professor of Clinical Medicine, University School of Medicine.

During the Renaissance, first place belongs to this abused and abusive personage, Paracelsus, refused to recognize the cleft between medicine and surgery. He was erratic and unbalanced and often lost in incomprehensible mysticism, but he nevertheless enunciated principles in most vehement vernacular which furnished impetus to all rebellious spirits of the time and have since been incorporated into modern surgery. He exclaimed: "If God will not help me, so help me the Devil." Even his religion was nonconformist. "He who depends on the Pope rests on the sands. He who depends on Zwingli depends on hollow ground. He who depends on Luther depends on a reed. They all deem each above the other and denounce one another as anti-christs, heathens and heretics, and are but four pairs of breeches from one cloth."



Philippus Aureolus Paracelsus
1493-1541

Paracelsus died a natural death at forty-nine years of age in 1541 at Salzburg, not murdered by assassins instigated by those against whom he directed his trenchant diatribes. Modern research has proved groundless the current rumors of a tragic exit. Thus ended the life of one of those warring knights who at all times and in all countries rise above the common order of mentality. Never a one will compromise truth for political or social expediency.

The eighteenth century furnished two gentle knights, Auenbrugger and Laënnec, prophets not



Benjamin Rush
745 8 3

without honor save in their own countries. Not until their books were published abroad and then distributed at home did the embitterment against them soften down. Auenbrugger's *Neue Erfindung mittels des Anschlagens an den Brustkorb als eines Zeichens verborgener Brustkrankheiten zu entdecken* remained practically unnoticed until Corvisart took it up in 1808, one year before its author's death. Laennec's cylinder of paper has become the foundation of our knowledge of diseases of the chest, and his book, *Traité de l'auscultation médiate* unlike Auenbrugger's, was translated at once into many languages.

A noble knight of the nineteenth century was the great Lister whose lance was his advocacy of the antiseptic principle in the practice of surgery. His Glasgow, Edinburgh and London migrations were due, in part to harsh treatment by his confreres in these respective cities, but never was he deterred from his firm conviction of the efficiency of antiseptics. Had he not had a backbone of steel our conception of antiseptics would have lain dormant for years.

The War of the Revolution was responsible for bringing to the fore three doctors who donned their armor in the cause of medicine in America. The Medical Department of the University of Pennsylvania was founded by two stalwarts in

medicine, John Morgan and William Shippen, both educated at Edinburgh and both imbued with the ambition to teach medicine. Dr. Morgan became professor of the theory and practice of medicine, and Dr. Shippen held the chair of anatomy and surgery. It was Morgan who published the first appeal for good medical education in America. Both men became Surgeons General of the United States, both were accused of malfeasance both were deposed and both later secured acquittal. The charges against them were brought by disgruntled subalterns, who, blaming old revolutionary ideas of equality could brook no precedence in office. Both retired to private practice and to teaching.

A third American knight of medicine was Benjamin Rush, younger than Morgan and Shippen, but conceded the final authority of all three medical in Philadelphia. Rush, too, was a professor in the University of Pennsylvania, and was also physician to the Pennsylvania Hospital, and founder of the Philadelphia Dispensary and treasurer of the United States Mint. His highly original mind made him the foremost American clinician of his time. Called the American Sydenham and the Hippocrates of Pennsylvania, he won fame as a fighter in the Philadelphia epidemic of yellow fever in 1793. He was one of the signers of the Declaration of Independence and was once a general for the Middle Department under Shippen. Deserting Washington at Valley Forge he joined the infamous 'Conway' Cabal against Washington's Fabian policy, but at long last deeply regretted his withdrawal as being ill conceived and rash.

When yellow fever was endemic in Philadelphia in the seventeen-nineties, the man in charge of the pest house was a Celt from North Carolina by the name of Charles Caldwell. A graduate of the University of Pennsylvania, he had had Rush as a preceptor. Caldwell wore his armor continuously and left an autobiography full of venom and rancor. *Persone non grata* to Rush he was forced to emigrate plodding across mountains and through woods to Lexington, Kentucky then the Athens of the region west of the Alleghenies. There amid the great oaks of the forest, he hoped to start a university the equal, if not the superior to that of Pennsylvania. Dr. Robert Peter says that he never heard even in Europe such lectures as filled the halls of this backwoods university. But Caldwell did not find the waters smooth and glassy and arguments concerning the cause of death were sometimes more easily settled by duels than by postmortems. The two most prominent faculty members of the infant Transylvania

nia University were Daniel Drake and the first ovariologist Ephraim McDowell. Transylvania's diminishing standard and ultimate downfall were due to warring religious sects which alternately held and lost control. But it is due to Caldwell's erudition and choice picking of incubula from the book stalls of Paris after the Napoleonic wars that gave to Transylvania one of the finest libraries in the country.

Caldwell's conception of Drake was that of a gentleman highly distinguished for his powers of mind and useful attainments, and unfortunately not less so for his propensity to strategy and intrigue which marred his usefulness and darkened his fame. First after Hippocrates and Sydenham to do much for medical geography, Daniel Drake stands in a unique position in relation to the topography of disease. Of log-cabin immigrant stock, Drake received the first medical diploma issued west of the Alleghenies, a diploma handwritten by that pioneer of vaccination in the West, William Goforth. He took his academic degree from Pennsylvania in 1815, then became one of Osler's 'peripatetic physicians' ever at war with man. He moved no less than seven times during his combative life as a teacher and was the founder of the Medical College of Ohio and of the Medical Department of Cincinnati College.

Drake also founded the most important medical periodical of the West at that time, the *Western Journal of the Medical and Physical Sciences*. This periodical, which died of circulation troubles in 1838, contains Drake's famed essays on Medical Education. The height of Drake's literary attainments, however, is his book on the *Diseases of the Interior Valley of North America* which might be called the victory of his Thirty Years War. In his quest for firsthand knowledge, this tall thin hardy man would turn up at a trapper's fire and gossip about the local medical situation or would surprise the country doctors by 'pumping' them on the climatological influence on the prevailing illnesses. All in all, Daniel Drake was Western America's most famous knight errant.

One of the men against whom Drake aimed a celebrated invective was Transylvania's lame duck professor Constantine Samuel Rafinesque. Rafinesque might be likened to the White Knight in *Alice* always wandering from the orthodox way of medical men and always falling on and off the horse of quackery. This odd knight in armor was a doctor only by courtesy, and after



Daniel Drake
1785-1852

one year at Transylvania, went to Cincinnati and joined one Thompson and one Swain in the methods of herbalists. Rafinesque demurely admitted sixteen different attainments in which he particularly excelled.

These are but a handful of the doctors in armor who have wended their way through the Medical Kingdom. Full of chivalry for the ill and oppressed, they have fought famous battles against disease and ignorance, have thrust many a stout lance at the enemy in the Tournament of Death, keeping ever in their hearts the Quest of Healing.

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REVIEWS OF NEW BOOKS

GREAT strides have been made in the management of the cancer problem in the past decade or two. The reason is obvious. Cancer is a disease that destroys approximately 185,000 individuals annually in the United States and on that basis it is fair to assume that another 500,000 are afflicted by it.

For many years a fatalistic attitude regarding cancer was almost universal both among the lay population and the medical profession. Due to this unfortunate attitude patients with cancer usually were seen and the condition recognized late as a result treatment was futile. However careful and persistent study of the nature of the disease its various types, and the process of its growth and dissemination brought forth evidence to form a premise which has been substantiated. The fundamental basis of this premise was that cancer is a local process in its beginning and may remain so for a short time. If it could be excised locally or destroyed by radiation in this stage cure would result. This took then was early recognition. This required the co-operation of the lay population and adequate training of the medical profession.

The American Cancer Society has done much in lay education during the past few years. In fact it seems that the lay population is becoming more cancer conscious than many of the medical profession. The busy physician has not time for and often no patience with the apparently well individual who fears cancer and yet the time the disease should be recognized is when symptoms are absent or very insignificant. Since the layman has been instructed regarding his needs the onus falls upon the medical profession to provide the service. It is recognized that certain internal cancers are difficult or impossible to detect in the early stages. Also it has been proved that in most instances elaborate and costly diagnostic procedures are not justified in the symptomless patient. However those anatomical areas of the body which can be examined readily without complicated procedures or special equipment are the site of about 60 per cent of all cancers. The justifiable conclusion is that physician must be made cancer conscious, develop skill in its early detection and make provision for adequate and proved therapeutic measures.

In recent years a number of excellent books on cancer and allied diseases have appeared. To this group can be added the recent work of Ackerman and Regato.¹ In surveying this book it is interesting to note that the authors assume a bold but absolutely just attitude on the cancer problem in its entirety.

¹CANCER: DIAGNOSIS, TREATMENT AND PROGNOSIS. By LAUREN V. ACKERMAN, M.D. and JOHN A. del REGATO, M.D. St. Louis: The C. V. Mosby Co. 1947.

Including the teaching of cancer to medical students, its early recognition and the therapeutic management.

The material is divided into two parts. The first part is devoted to phases of general interest. Chapter 1 includes an introduction to the subject and elaborates upon some of the issues mentioned previously. The incidence of cancer is discussed and early diagnosis stressed. A chapter is devoted to pertinent research work that has been done. This includes such topics as spontaneous tumors in animals, the rôle of heredity, carcinogenic agents, estrogens, and other hormones, the x-ray dyes, roentgen ray and ultra violet radiation, parasites, viruses, precancerous changes, carcinogenesis *in vitro*, chemical characteristics of neoplasms, transplantation of tumors, cancer theories and conclusions. A chapter is given over to pathology. This incorporates biopsy, fixation and staining methods, specialized procedures such as the aspiration biopsy, cell studies, frozen section work, differentiation between benign and malignant tumors, the spread of tumors and the like. A chapter is devoted each to surgery and radiation therapy of cancer. These five chapters are intensely interesting and contain a tremendous amount of pertinent information.

The second part is divided according to systems or organs. A chapter is assigned to each of the following: Cancer of the skin, cancer of the respiratory system and the upper digestive tract, tumors of the thyroid gland, tumors of the mediastinum, cancer of the digestive tract, cancer of the genitourinary tract, cancer of the male genital organs, tumors of the suprarenal gland, cancer of the female genital tract, cancer of the mammary gland, malignant tumors of bone, sarcomas of the soft tissues, cancer of the eye, Hodgkin's disease and the leucemias. The material in each chapter or subdivision is divided into anatomy, incidence, etiology, pathology, clinical evolution, diagnosis, treatment and prognosis. Under the heading of anatomy special attention is given to the lymph drainage. This is illustrated by excellent drawings and is a definite aid to the cancer diagnostician and therapist. Under treatment no great amount of detail of therapeutic technique is given. Those procedures, whether surgical or radiologic that have been found to be most successful either by the authors or others qualified are presented. Well controlled statistics are included. At the end of each chapter or subdivision is appended a bibliography.

The entire subject of cancer, exclusive of the nervous system, is extremely well presented, but some portions seem worthy of special attention. The chapter on cancer of the respiratory system and upper digestive tract merits praise. Tumors of the

nasal fossae, the maxillary sinus the floor of the mouth, the gingivae palate, nasopharynx, tonsil periepyglottic area, laryngopharynx and endolarynx are discussed in much detail. Tumors of these sites so often overlooked or neglected are deserving of special attention. This chapter of 281 pages is illustrated by 230 illustrations and three colored plates.

The chapter on the mammary gland does not seem quite to meet the standards set in the remaining portion of the book. Many of the illustrations depict far advanced stages of the disease. It might be wiser to focus the attention of the reader more upon the very early clinical signs of the disease. Dimpling of the skin or dimpling that can be elicited by special maneuvers is not mentioned.

This work of approximately 2100 pages with 745 illustrations and 42 colored plates is a welcome addition to the working library of every physician but should be of special interest to those interested specifically in cancer. The presentation is excellent the text is easy to read and the illustrations are illuminating.

The conclusions are sane not only from the standpoint of cancer in general as a highly destructive disease but in the admonition to the medical profession to prepare itself to meet the challenge confronting it.

JOHN A. WOLPER.

THE Handbook on Fractures by Duncan Eve¹ is well illustrated and contains valuable information recorded by the author from his experience of more than 40 years of trial and error in the field of fracture work.

All of the common fractures are well discussed and illustrated and a good number of complicated fractures are also included. This handbook will provide a ready reference in the treatment of most fractures. In a limited number of pages a complete discussion of all fractures cannot be made but the most important everyday fractures are included and discussed.

This volume deals entirely with the treatment of fractures. No attempt has been made to elaborate on the type of injury or signs and symptoms of fractures, but the entire emphasis is placed on the details of treatment.

In the preface the author includes one sentence that is intriguing. "There is no wrong way of treating fractures as long as success is achieved." While one does not entirely agree with all of the forms of treatment advocated by the author the above quotation justifies his method of treatment.

JAMES J. CALLAHAN

HAND BOOK ON FRACTURES. By Duncan Eve J. M.D. F.A.C.S. In collaboration with Trimble Sharber A.B. M.D. St. Louis The C. V. Mosby Co. 1947.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

SOURCE BOOK OF ORTHOPAEDICS. By Edgar M. Bick, M.A. M.D. F.A.C.S. 2nd ed. Baltimore The Williams & Wilkins Co., 1948.

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CLINICAL CONGRESS AMERICAN COLLEGE OF SURGEONS

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PRELIMINARY PLANS FOR 1948 CLINICAL CONGRESS THE BILTMORE HOTEL LOS ANGELES OCTOBER 18 TO 22 1948

THE thirty fourth Clinical Congress of the American College of Surgeons will be held in Los Angeles at the Biltmore Hotel from October 18 to 22 1948. Under the leadership of a strong and enthusiastic Committee on Arrangements, plans are under way for a complete and varied program for the 5-day meeting. The hospitals and medical schools will cooperate in scheduling operative clinics and demonstrations. Visiting surgeons will have ample opportunity to attend well arranged programs of many different kinds in the hospitals. A committee is looking into the possibility of telecasting operations to the Hotel Biltmore. After the exceedingly successful demonstration of the teaching value of television at the Clinical Congress in New York last year it is hoped that this medium can again be used.

In addition to meeting rooms in the Biltmore Hotel the Biltmore Theater and the spacious Philharmonic Auditorium across the street from the hotel will be used for the larger audiences. The capacity of the Philharmonic Auditorium is 2700 and that of the Biltmore Theater about 1700.

PRESIDENTIAL MEETING AND CONVOCATION

The opening evening session of the Clinical Congress will be devoted to the Presidential Meeting at which the officers-elect, consisting of Dr Dallas B Philmiste of Chicago as president, Dr

Howard A. Patterson of New York as first vice president, and Dr Carl H. McCaskey of Indianapolis as second vice president will be installed. Dr Arthur W. Allen of Boston, president and vice-chairman of the Board of Regents, will preside and will deliver the Presidential Address. The third Martin Memorial Lecture will be delivered by Dr Clarence Crafoord, Professor of Surgery University of Stockholm.

The annual Convocation will be held on the final evening, Friday. The formal initiation ceremonies and the presentation of the Fellowship Address by Dr L. A. Durbridge, President California Institute of Technology Pasadena, will constitute the program. Dr Durbridge's subject will be "The Physician Meets the Doctor."

SCIENTIFIC SESSIONS

The scientific sessions, to be held on Tuesday, Wednesday and Thursday evenings, will be devoted to subjects in general surgery carefully selected for their current interest, presented by authoritative speakers in their fields. On the same evenings separate scientific sessions will be arranged for specialists in ophthalmology and otorhinolaryngology. Every afternoon, from Monday through Thursday panel discussions will be held. These will be led by outstanding surgeons in each particular field. A symposium on fractures and other traumas and a symposium on cancer are planned for two afternoons.

OPHTHALMOLOGY AND OTORHINOLARYNGOLOGY

In addition to the evening sessions on ophthalmology and otorhinolaryngology which are scheduled for Tuesday Wednesday and Thursday evenings, there will be meetings for specialists in these fields on the same mornings. The sessions in otorhinolaryngology will follow those in ophthalmology so that surgeons who combine these specialties in their practice can attend both meetings. In planning all of the meetings in these fields, the suggestions of the members of the Advisory Council on Ophthalmology and of the Advisory Council on Otorhinolaryngology are followed in an effort to have the programs meet the ideas of the surgeons who practice these specialties.

FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

The Forum on Fundamental Surgical Problems, one of the most popular features of Clinical Congresses during the past few years, will be held on Tuesday Wednesday Thursday and Friday mornings, in two or three sections meeting concurrently. Brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties will be presented under the general direction of Dr Owen H. Wangensteen, chairman of the committee, Forum on Fundamental Surgical Problems.

HOSPITAL CONFERENCES

The opening meeting of the twenty seventh Hospital Standardization Conference will constitute the first formal session of the Clinical Congress, and will be a General Assembly for both surgeons and hospital representatives. Dr Arthur W. Allen of Boston, president of the College, will preside.

The hospital conferences will continue on Monday afternoon, with sessions following on Tuesday Wednesday and Thursday mornings after noons, and evenings.

Hospital trustees, administrators, heads of the various hospital departments and their personnel, nursing groups, and many other persons directly or indirectly concerned about hospital progress are invited to participate in the discussions at the hospital conferences, at which leaders in the hospital field are the speakers and the moderators. The meetings will include formal sessions, panel discussions, round table conferences, symposia and forums.

A meeting which is always of great interest to hospital administrators and members of medical staffs in hospitals, as well as to surgeons, is the Symposium on Graduate Training in Surgery,

which is scheduled for Thursday afternoon after the annual meeting of Fellows.

MEDICAL MOTION PICTURES

An appreciated feature of the Clinical Congress will again be the showing of medical motion pictures each day. The latest available pictures on surgery and related subjects will be presented. Special showings will be arranged of medical motion pictures in the fields of ophthalmology and otorhinolaryngology. Both sound and silent films will be shown, all of which will have been approved by the Committee on Motion Pictures. Some of the newer medical motion pictures now under production will be shown.

TECHNICAL AND SCIENTIFIC EXHIBITION

The Technical and Scientific Exhibits will occupy the Ballroom foyer, the Renaissance Room, and the Galleria of the Biltmore Hotel according to present plans. Leading manufacturers of surgical instruments, x-ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds and pharmaceuticals, and publishers of medical books will be represented.

ADVANCE REGISTRATION

Surgeons who wish to attend the Congress should register in advance. No registration fee will be charged Fellows whose dues are paid to December 31, 1947. For endorsed Junior and Senior Candidates the fee will be \$5.00. Non-Fellows attending as invited guests of the College will pay a fee of \$10.00. No fee will be required of initiates of the class of 1948.

HOTEL RESERVATIONS

It is desirable to make hotel reservations as early as possible because of the shortage of hotel rooms that prevails in Los Angeles as well as in other cities. In making these, communications should be addressed to the Los Angeles Convention and Visitors Bureau, care of the Los Angeles Chamber of Commerce, stating that you will be attending the Clinical Congress of the American College of Surgeons. All hotel reservations for the Clinical Congress are to clear through this Bureau. No correspondence should be sent directly to the hotels. A form for reservations was enclosed in the letter recently sent to Fellows. Choice of hotels may be designated. The hotels in Los Angeles require a deposit in advance.

There follows the list of member hotels, Convention and Visitors Bureau, Los Angeles Chamber of Commerce.

LOS ANGELES HOTELS

	Rates (as of May 5 1947)		Double	T h
	Subject to Change	Double		
Alexandria, 10 West 5th St.		\$ 6.00 up	\$ 7.00 up	
Ambassador, 3400 Wilshire Blvd	\$ 6.00-7.00	\$ 6.00-7.00		
Biltmore, 515 South Olive St.	\$ 7.50-8.00	\$ 7.50-8.00		
Chancellor, 309 West 7th St.	\$ 4.50-6.00	\$ 4.50-6.00		
Chapman Park, 34 Wilshire Blvd.	\$ 6.00-7.00	\$ 7.00-8.00		
Clark, 426 South Hill St.	\$ 4.50-5.00	\$ 5.50-6.00		
Commodore, 203 West 7th St.	\$ 3.00-3.50	\$ 4.00		
Linmar, 235 South Hope St.	\$ 3.00	\$ 3.00		
Figueroa, 939 South Figueroa St.	\$ 3.00-4.00	\$ 3.00		
Gates, 6th and Figueroa Sts.	\$ 3.50-6.00	\$ 3.50-6.00		
Gaylord, 3355 Wilshire Blvd.	\$ 7.50 up	\$ 7.50 up		
Hayward, 6th and Spring Sts.	\$ 5.00	\$ 5.50		
Hollywood Drak, 6724 Hollywood Blvd.	\$ 3.50 up	\$ 4.50 up		
Hollywood Hotel, Hollywood at Highland			\$ 5.00-6.00	\$ 5.00-6.00
Hollywood Knickerbocker, 1044 Ivar St.			\$ 6.00 up	\$ 6.00
Hollywood Plaza, 1637 No. Vine St.			\$ 4.00 up	\$ 4.50 up
Hollywood Roosevelt, 7000 Hollywood Blvd.	\$ 7.00 up	\$ 8.00 up		
Kipling, 4077 West Third St.	\$ 3.00	\$ 3.50-4.00		
Lankenshim, 230 West 7th St.	\$ 3.00-4.50	\$ 4.50-7.00		
Majayan, 3049 West 8th St.	\$ 4.00-5.50	\$ 5.00-7.50		
Mayfair, 1256 West 7th St.	\$ 5.00 up	\$ 6.00-7.00		
Natick, 108 West 5th St.			\$ 4.00-8.00	\$ 4.50-9.00
Roselyn, 11 West 5th St.			\$ 4.50	\$ 6.00
San Carlos, 507 West 5th Street			\$ 4.50-5.50	\$ 4.50-7.50
Savoy, 6th St. and Grand Ave			\$ 4.00	\$ 4.00
Town House, 639 Commonwealth Ave.				

PARTICIPATION IN THE FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

OWEN H WANGENSTEEN M.D. F.A.C.S. Minneapolis, Minnesota

THE Board of Regents of the American College of Surgeons has again appointed a committee to invite and pass on the merits of the abstracts submitted and to select the papers for presentation in the Forum on Fundamental Surgical Problems at the next session of the Clinical Congress. In selecting papers for the Surgical Forum the committee is guided by originality of thought and interest suggested in the abstract submitted by the author. The Surgical Forum is concerned more with new work than with the dissemination of old information. Each speaker will be allowed 10 minutes for his presentation.

The final selection of papers for the Los Angeles meeting (October 18 to 22 1948) will be made by the committee in the near future. Anyone in

Chairman of Program Committee on Surgical Forum.

interested in participating in the program is invited to send before May 15 1948, the title of his presentation accompanied by an abstract of not more than 200 words, to

Forum on Fundamental Surgical Problems
American College of Surgeons
40 East Erie Street
Chicago 11 Illinois

The author may submit his paper for publication wherever he wishes.

Committee Forum on Fundamental Surgical Problems

Owen H. Wangenstein, Minneapolis, Chairman
Warren H. Cole, Chicago
Frederick A. Collier, Ann Arbor
Robert A. Gross, Boston
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May, 1948

SURGERY
GYNECOLOGY AND OBSTETRICS
Supplement

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COLLECTIVE REVIEW

THE PHYSIOLOGICAL BASIS FOR RESUSCITATION OF THE NEWBORN

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A CENTURY now has passed since Sir James Simpson introduced both the use of the volatile anesthetic agents into obstetrics and the anesthesiologist into the confines of the delivery room. In the course of these hundred years, the anesthesiologist has come to join the obstetrician in being responsible not only for the safe and painless labor of the mother but also for the safe deliverance of her infant, including when necessary the resuscitation of that infant. This last responsibility is an eminently appropriate one the anesthesiologist being a specialist in the field of resuscitation. The fact that our fetal and neonatal mortality rates are improving but little, plus the fact that certain resuscitative procedures widespread in practice are based on extremely precarious physiological thinking suggested that it would be appropriate to review the literature on the subject of asphyxia neonatorum and its proper treatment.

THE INITIATION OF RESPIRATION IN THE NEWBORN

The age-old question of how breathing is initiated at birth remains one of science's greatest enigmas but some progress is being made toward the answer.

The time of onset of respiratory activity There is now evidence to indicate that respiratory movements are not necessarily initiated at or after birth they may begin in utero. Ahlfeld called attention to intrauterine respiratorylike move-

ments of the human fetus which he recorded graphically from the surface of the mother's abdomen and Snyder and Rosenfeld have succeeded in making motion pictures of such movements (214). Similar generalized rhythmic patterns which bear a close resemblance to respiratory movements have been observed prenatally in a variety of animals including the sheep (7, 8) the goat (6, 9) the rat (33) the rabbit (212) the guinea pig (213) the cat (213) the monkey (65) the chick (247, 253) and the duck (252).

A second line of evidence that the genesis of respiratory activity extends far back into embryonic life is furnished by observations of the respiratorylike behavior of human fetuses delivered early in their gestational lives. Erbham saw a 4 month old fetus open its mouth as though to breathe and Minkowski noted a deep inspiratory movement of the thorax in a fetus of the same age (158). Dragstedt observed a 4 month old fetus which executed rhythmic movements of the head and trunk as well as inspiratorylike movements resembling gasps (251) and Greene observed another fetus of that age in which 3 distinct respiratory movements were discerned (251).

Yet a third line of evidence of fetal respiratory activity is the demonstration of the entrance of amniotic fluid into the lungs before birth. It has long been known that amniotic fluid may become infected following premature rupture of the membranes (204) and it is now apparent that such infected fluid may enter the fetal lungs and cause intranatal pneumonia. Thus, Browne (20, 21)

Johnson and Meyer Warwick Odell and Plasz, Helwig Cruickshank Chase, Potter (175) Cameron and Farber and Sweet all reported finding either pneumonia or constituents of amniotic fluid in the lungs of stillborn infants. Snyder and Rosenfeld have performed experiments on animals to show that amniotic fluid enters the fetal lungs; they injected India ink into the amniotic sac of the rabbit and then demonstrated a flow of ink-stained amniotic fluid into the alveoli that was proportional to the rate of fetal respiratory activity (209 210 211 215 216 217) Shock has confirmed this work in the rat, but along with many other workers, he believed the phenomenon to occur only under conditions of intrauterine asphyxia. The entrance of amniotic fluid into the lungs before birth has also been shown by the technique of obtaining x rays of the fetus following the injection of thorotrast into the amniotic sac. Windle Becker Barth and Schulz (249) showed that thorotrast introduced about the head of the guinea pig fetus may be aspirated and demonstrated by means of x-rays. Ehrhardt and Reifferscheid and Schmiemann are reported to have injected thorotrast into the amniotic sacs of human patients before therapeutic abortion and subsequently to have found the radiopaque substance in the fetal gastrointestinal tract and lungs. Davis and Potter (49) injected thorium into the amniotic sacs of 16 women in the first half of pregnancy before therapeutic hysterotomy and demonstrated thorotrast in the gastrointestinal tracts and lungs of all the fetuses microscopically. They repeated these experiments in 10 women in the second half of pregnancy before cesarean section, and radiographic studies of the infants following delivery showed thorotrast in the lungs in half of them.

The mechanism of onset of respiratory activity. A number of theories have been propounded to explain the mechanism of onset of fetal respiratory activity and the initiation of the first inspiratory gasp of the newborn. An early one was Preyer's mechanical theory which attributed the initiation of respiration at birth to physical factors and the reflex stimulation of the respiratory center by the trauma of labor. This view is refuted empirically by the failure of rough palpation manual version and the application of forceps to initiate breathing if the fetus placental circulation remains intact (73).

As the facts concerning the chemi- respiration became known, various theories were postulated. It is a well-known fact that clamping the umbilical cord the first inspiratory gasp (24, 28)

hypothesized that the onset of respiration occurred because of insufficient oxygen, an excess of carbon dioxide, or a change in the pH of the blood. Windle Barker and their coworkers do not believe that fetal respiratory activity occurs under normal physiological conditions, and they believe that such activity as well as the initiation of respiration after birth is dependent upon asphyxia, anoxemia, and an increasing tension of carbon dioxide (6 8, 12 239 244, 245, 247 248, 249, 251 252 253). A number of other workers support these views (25, 80 97 122 173 201 256). Henderson and his followers have stressed that it is the carbon dioxide tension of the blood that is the excitatory stimulus of respirations (1 102, 104, 105 108 238, 243). Coryllos (34) stated that the true respiratory hormone is the pH of the blood, and that the important factor is the carbonic acid-bicarbonate ratio rather than the absolute value of the carbon dioxide tension.

Snyder and Rosenfeld and Eastman have advanced what may be termed the biological theory of the initiation of respiratory activity. They have shown that anoxemia and an increased tension of carbon dioxide may actually inhibit fetal respiratory efforts (212, 213 188) and that the onset of respirations at birth cannot be correlated with the tension of carbon dioxide in the infant's blood (69). Snyder and Rosenfeld have further demonstrated that the tidal flow of amniotic fluid into the lungs results in alveolar distention (211). They have postulated that the fetus is not normally apneic in utero; that postnatal breathing is merely a continuation of intrauterine respiratory activity and that asphyxia neonatorum represents a suppression of this activity (187 189). Davis and Potter reached the similar conclusion that the respiratory activity of the human fetus *in utero* is related to that after delivery; the major change in respiration at birth involving the substitution of air for amniotic fluid as a medium of exchange (249).

Apparently intranatal respiratory activity definitely does occur but whether it occurs as a normal function related to postnatal respiration, or merely as a manifestation of intrauterine asphyxia, cannot be ascertained on the evidence so far presented.

neonatorum should be reserved for those infants exhibiting the true syndrome of asphyxia

Classification. Although numerous classifications of the stages of asphyxia neonatorum have been devised, they all share a common basis: they describe varying degrees of lack of oxygen. Thus, one group of workers speaks of asphyxia livida and "asphyxia pallida" (151 185 203) a second group of initial apnea 'initial dyspnea, terminal apnea, and arrest of the heart (34 35 223) and a third group of mild moderate, and severe asphyxia (83 136 144, 193) Flagg's classification describes the degree of lack of oxygen in terms of physical findings—the stage of depression, the stage of spasticity and the stage of flaccidity—a classification of immediate importance to those faced with the necessity of resuscitating the asphyxiated newborn (86)

In the depressed stage the baby does not breathe well. There is a tendency to recurring cyanosis or duskiess. The infant is depressed but capable of being aroused the respiratory center circulates, muscular tonus, and reflexes are all depressed from anoxemia but are easily stimulated to normal activity. In the spastic stage respirations are irregular gasping or shallow and occur at long intervals. There is marked cyanosis of the mucous membranes. There is reflex reaction to aspiration within the pharynx and an active glottic reflex is present. Froth or fluid appears in the mouth and pharynx. In the flaccid stage, respirations occur either at long intervals or cannot be demonstrated. There may be either cyanosis or pallor. There is complete flaccidity of all the musculature the jaw is completely relaxed the glottic structures are collapsed and there is no resistance on exposure of the pharynx. Fluid is found in the hypopharynx. All reflexes are in abeyance. Cardiac pulsation may or may not be demonstrable at the apex. The circulation is failing (86)

Etiology. The list of the etiological factors of asphyxia neonatorum is a long one, and the complete syndrome is usually the result of a combination of several of these factors, rather than any given single factor in itself

It has been found that the age of the mother is of no importance until the age of 40 years is reached but that thereafter the incidence of asphyxia increases markedly (143 194) The parity of the mother is a factor primiparas giving birth to asphyxiated babies more frequently than multiparas (30) until after the eighth baby when the incidence of asphyxia increases with parity (142) The health of the mother is also a factor cardiac

disease cardiac failure, anemia pulmonary disease, infectious diseases of the genitourinary or gastrointestinal tracts, metabolic diseases such as diabetes or thyrotoxicosis, deficiency diseases, hyaline pertussive states, and the toxemias of pregnancy all markedly increase the incidence of asphyxia (11 27 142 170, 193)

The viability of the germ plasma and the development of fetal disease or congenital anomalies may be of importance. Congenital debility congenital defects such as malformations of the respiratory and circulatory systems, diaphragmatic hernia, hypoplasia of the mandible, abnormal mobility of the tongue and congenital diseases such as syphilis and erythroblastosis, have all been cited as factors tending to induce asphyxia (13 27 67 146 170)

There is little doubt that the immaturity of the infant plays an important part in the production of asphyxia neonatorum (13 27 30 128 170 176 193 194, 229) Lund considered that immaturity constituted the most important single factor in the production of asphyxia neonatorum (142) as did Sege. However Eastman states that while prematurity is a common cause of death it is not, *per se* a prominent cause of asphyxia neonatorum (67) Some credence is lent this statement by the experimental work of Glass and Snyder who found an increased tolerance to anoxia in rabbits, dogs, and guinea pigs born prematurely

The presentation and position of the fetus in utero (breech transverse, and occiput posterior presentations and positions) are factors which increase the incidence of asphyxia (27, 142) The induction of labor with drugs, particularly quinine and pituitrin, is said to be a factor in producing asphyxia in some instances (11 52 142) The duration and type of labor is of importance long dry labor or the long difficult labor associated with dystocia and cephalopelvic disproportion markedly increases the tendency toward asphyxia (11 27 142 146 170) as does the pernicious practice of prolonging labor by mechanical force to prevent the delivery of the infant merely for the sake of convenience (52) Russ and Strong thought that prolonged labor was the outstanding cause of fetal asphyxia (194)

The complications of labor are important factors. These include anoxemia of placental origin such as gross infarction low insertion placenta previa, and premature separation of the placenta anoxemia originating in the cord due to placental shortness, knotting or kinking the cord about the neck, compression or torsion or a velamentous rupture and anoxemia of uterine origin such as tetany a contraction ring or hemorrhage (11 27

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As the facts concerning the chemical control of respiration became known, various chemical theories were postulated. It is a well known fact that clamping the umbilical cord often initiates the first inspiratory gasp (24, 28) and it has been

hypothesized that the onset of respiration occurred because of insufficient oxygen, an excess of carbon dioxide or a change in the pH of the blood. Windle Barker and their coworkers do not believe that fetal respiratory activity occurs under normal physiological conditions, and they believe that such activity as well as the initiation of respiration after birth, is dependent upon asphyxia, anoxemia, and an increasing tension of carbon dioxide (6 8 12 239 244, 245 247 248, 249, 251, 252 253). A number of other workers support these views (25 80 97 122 173 201 256). Henderson and his followers have stressed that it is the carbon dioxide tension of the blood that is the excitatory stimulus of respirations (1 202, 204, 205, 208 238 243). Coryllos (34) stated that the true respiratory hormone is the pH of the blood, and that the important factor is the carbonic acid-bicarbonate ratio rather than the absolute value of the carbon dioxide tension.

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Apparently intrauterine respiratory activity definitely does occur but whether it occurs as a normal function related to postnatal respiration, or merely as a manifestation of intrauterine asphyxia, cannot be ascertained on the evidence so far presented.

ASPHYXIA NEONATORUM

Asphyxia means, literally, the absence of pollution. In common medical parlance, however, asphyxia neonatorum has come to mean the failure of the newborn to breathe at birth. Apnea neonatorum would appear to be better terminology to employ in such instances, and the term "asphyxia

128, 142 146 177, 185 193 194 229) The type of delivery also influences the incidence of asphyxia. Version and extraction high forceps, breech extraction, mid-forceps, cesarean section and low forceps delivery without episiotomy are associated, in the order given with a frequency of asphyxia which is higher than that with spontaneous delivery (27 30, 52 128, 142 193 194).

The analgesic drugs often play a major role in the production of asphyxia neonatorum. Irving reported that if neither analgesics nor anesthetics were given to the mother, only 1.9 per cent of the infants failed to breathe immediately at delivery whereas from 30 to 60 per cent of the infants born to narcotized mothers were asphyctic. Experimental work has shown that the intrauterine respiratory activity of the fetus is inhibited by the administration of pentobarbital sodium amylal morphine paraldehyde, or chloral hydrate to the mother (18 187 189). Morphine in particular has been condemned (22 129 134, 174 195) especially when used in large doses within 1 to 6 hours of delivery and in conjunction with other methods of analgesia and anesthesia (27 29 112 145 202 219). The barbiturates, when first introduced were regarded as the answer to the problem of obstetrical analgesia (19, 54, 139, 186) but it has become apparent that they too contribute to fetal respiratory depression (16 22 29, 112 120, 134, 195). Demerol, scopolamine, paraldehyde, heroin and pantopon all increase the frequency of asphyxia in the infant (92 120 129 142 190). The pain-relieving drug that does not increase the incidence of asphyxia neonatorum has not yet been found.

All the anesthetic agents and methods play a part in the production of asphyxia neonatorum with the possible exception of local infiltration with or without peripheral nerve block (26 36 52 141). Spinal continuous spinal, caudal, and continuous caudal anesthetics are almost ideal from the viewpoint of prevention of asphyxia in the fetus, except when these methods are complicated by a decrease in the blood pressure or by manifestations of idiosyncrasy (36 96 196 218 227). All general anesthetics used to the point of maternal anesthesia decrease the respiratory response of the newborn (98). Nitrous oxide produces marked anoxemia of both the maternal and fetal bloods (205) and it is exceedingly dangerous to the fetus in concentrations greater than 85 per cent (66). Cyclopropane increases the oxygenation of the maternal blood, but it is claimed to oxygenate the fetal blood poorly (205) and, when used in concentrations sufficient for operative delivery increases the incidence of asphyxia (144).

Ether depresses intrauterine fetal respiratory activity (18) decreases fetal oxygenation (66), and narcotizes the infant (96, 208). In short, anesthesia, like analgesia, is produced for the mother with the hazard of asphyxiating her child.

Finally and frequently most importantly the skill and experience of both the obstetrician and anesthetist may influence the incidence of asphyxia neonatorum (27).

Chemistry Eastman's classical studies of the chemical changes occurring in the blood of the asphyxiated newborn (63 64, 68, 69, 70, 71), confirmed by others (95, 123 132 205, 243) indicate that asphyxia neonatorum is a chemical phenomenon associated with a decrease in the concentration of oxygen, an increased tension of carbon dioxide, a marked increase in lactic acid, and a decrease in pH of the fetal blood. In the normal newborn, the arterial oxygen capacity is 15 ml (20.8 volume per cent) the arterial oxygen content low (10.5 volume per cent) and the arterial oxygen saturation therefore, low (50.5 per cent). In asphyxia neonatorum, the oxygen content of the blood may fall to less than 1 volume per cent with a fatal outcome and the oxygen saturation may be only between 0.5 and 4.0 per cent. The lactic acid content of the blood of the normal newborn is 35 milligrams per 100 cubic centimeters, but under conditions of asphyxia this may rise to from 85 to 100 milligrams per 100 cubic centimeters, which indicates a definite endogenous production. The carbon dioxide tension of the blood, which is normally 32 millimeters of mercury in the newborn, rises to twice that value in asphyxia neonatorum, and at the same time the carbon dioxide content falls to low levels as a result of its displacement from base by the large amount of lactic acid present in the blood. The pH of the blood, normally 7.35 in the newborn falls to 7.05 the lower level compatible with life, and may even fall to below 7.00 with a fatality ensuing.

Pathology Although it has been demonstrated experimentally that intrauterine respiratory activity and the aspiration of amniotic fluid produces some dilatation of the pulmonary alveoli under certain circumstances (216) clinically the fundamental pathological lesion of asphyxia neonatorum is the complete atelectasis of the lungs. The lung is airless and is not crepitant, the alveoli are collapsed and the parenchyma is fleshy and dark colored. The lung is a compact, solid viscus which completely fills the thorax, for negative intrapleural pressure has not been developed (14). Even after respiration begins, partial atelectasis may persist for long periods (62 105). Wason has shown roentgenographically that expansion of the

between the carbon dioxide tension and the onset of spontaneous respirations in the newborn (60) and others have confirmed the fact that the use of carbon dioxide in conjunction with the administration of oxygen will not initiate respirations more readily than, and indeed not even as readily as oxygen alone (1 13 44 64 68 98 13 169 170 212 213). Furthermore it has been pointed out that carbon dioxide in concentrations above 10 per cent exhibits its anesthetic properties and becomes actually depressant to respirations (15 55 119). In fact, under conditions of anoxia the respiratory center undergoes a reversal as far as its response to carbon dioxide is concerned and eventually even low concentrations of that agent may be depressant. Finally with the occurrence of what Schmidt terms the revolution in respiratory physiology it has come to be realized that when the respiratory center is depressed the impulses for the stimulation of respiration arise from the aortic and carotid bodies (which are very sensitive to anoxia but relatively insensitive to increased carbon dioxide tensions) as well as from the respiratory tract joints skin and subcutaneous tissues (31 32 67 107 198).

Methods of artificial respiration. When the newborn remains apneic following the establishment of an unobstructed airway the administration of oxygen through that airway becomes a problem of artificial respiration. Such artificial respiration must exert sufficient force to overcome the resistance of the atelectatic lungs to expansion. Wilson and Farber found that this resistance amounted to from 25 to 30 centimeters of water in the lungs of premature infants at autopsy (206). Smith found the resistance to be from 20 to 30 centimeters of water in the lungs of normal human infants at birth (206). Gruenwald who believes that surface tension is the highest single factor of resistance to expansion in the lungs of the newborn found that an average pressure of 18 centimeters of water was required to expand the lungs of the newborn and stillborn when air was employed but that only 9 centimeters of pressure were required when water was employed to expand such lungs. Wilson Torrey and Johnson (243) concluded that pressures of 24.4 centimeters of water were not great enough to expand the lungs of stillborn infants but were great enough to cause gross pulmonary damage. Others have warned that even low pressures may cause alveolar rupture or vascular damage in the lung. Murphy and Bauer warned that in the Drinker type of respirator the negative pressure must not exceed 15 centimeters of water (161). Kreiselman (131) advised a maximum of 21.6 centimeters of

water positive pressure applied over the face. Flagg advocated 5.4 centimeters of water positive pressure (82) and Henderson allowed 5 millimeters of mercury positive pressure (107). The Drinker infant resuscitator provides a negative pressure of 10 centimeters of water (163) the Kreiselman inhalator a positive pressure of up to 16 millimeters of mercury (130) and the Ericson and Johnson resuscitator a positive pressure of 13 millimeters of mercury and a negative pressure of 9 millimeters of mercury (40). It is an enigma that the mechanical resuscitators for use in the treatment of asphyxia neonatorum provide pressures that are far lower than those estimated to be required to overcome the resistance of the lungs of the apneic newborn and yet that those same pressures may produce gross pulmonary damage in such lungs. At least a partial explanation lies in the fact that pulmonary damage may be as much dependent upon the suddenness with which such pressures are applied as upon the pressures themselves.

Artificial respiration may consist of the intermittent exaggeration of negative intrapleural pressure the intermittent increase of the pressure in the alveolar spaces, or the alternating increase and decrease of the pressure in the alveolar spaces.

Manual artificial respiration consisting of the intermittent compression of the lower thoracic cage and thus a method depending on the exaggeration of negative intrapleural pressure is often advocated (2 8 154 166 185 203). This resuscitative procedure may be combined with the use of oxygen supplied by machines such as the Henderson and Haggard inhalator (103 115) or by a simple mask and bag. Once spontaneous respirations have been initiated it may be possible to aid and assist them in this way. However there is no physiological basis for the use of this procedure in the face of persistent apnea for it is not possible to exaggerate a negative intrapleural pressure that has not yet developed. It is not possible to force air out of completely atelectatic lungs. It is not possible to accomplish an inspiratory act by the elastic recoil of an atonic thoracic cage (1, 2 52, 10 132 136 153 43).

The rocking method of artificial respiration developed by Eve (7 8 70 15) has been used in the resuscitation of the asphyxiated newborn (8, 157). This method also consists of the development of an increased negative intrapleural pressure but it is doubtful whether in most cases the weight of the abdominal viscera can produce sufficient negative intrapleural pressure to overcome the atelectasis of the apneic newborn (243). The procedure has the added theoretical disadvantage

delenburg position (52 67) is now considered the optimal position for the asphyxiated newborn.

If the infant is in the stage of flaccidity with collapsed glottic structures and absent glottic reflex, it is mandatory to intubate the trachea not only for the purpose of aspiration but also in order to maintain an airway through which the lungs may be insufflated with oxygen (3 4 17 52 83 84, 93 118 132 136 140 146 149 152 202 229 230). Ardent advocates of this operation believe that it is easily performed after but little training (82 152 243 254) by either a 'blind technique' (51 149) or with specially designed infant laryngoscopes (3 17 83 84 85, 86, 137 146 218 228 232). The more conservative writers warn that it is a maneuver that requires considerable skill, and that the novice may find it both slow and difficult to accomplish (166) without trauma to the larynx (82 138 220, 229).

The use of external stimulation. Few workers still advocate the Schultze Giant Swing (185) the performance of a gentle dorsal slit (152) hot and cold tubbing, sprinkling the skin with ether, jack-knifing the infant, dilating the anal sphincter, vigorous spanking, pummeling and other archaic methods of manhandling the asphyxiated infant in the hope of stimulating the respiratory center with afferent impulses. Gentleness is now stressed and the dangers of increasing shock, causing visceral lacerations, and inviting cerebral hemorrhage are emphasized (1 34, 52, 102 132 137 154 166 196, 202 230). Nevertheless, the anoxic respiratory center may be stimulated by afferent impulses from the skin, subcutaneous tissues and joints (31 32 61 197 198) and gentle cutaneous friction and passive movements of the extremities, after the establishment of an unobstructed airway, may effect the initiation of respiration in the mildly depressed newborn without the necessity of recourse to other procedures (112 193 118 218 228).

The administration of oxygen. If the newborn does not respond immediately to such measures, oxygen must be administered. Eastman (63) as noted before, has demonstrated that the oxygen content of the fetal blood is reduced to extremely low levels. He believes that although the changes in lactic acid content, pH and carbon dioxide tension are marked (64, 68 69, 70, 71) these changes are secondary the primary chemical change in asphyxia neonatorum being the extreme reduction in the oxygen content of the infant's blood. He has summarized his firm convictions by stating, "There seems to be only one urgent indication in the treatment of asphyxia neonatorum, and that is to introduce oxygen into the cir-

culating blood of the infant." There is unanimous agreement among almost all other authorities that the administration of oxygen constitutes one of the essential procedures in the resuscitation of the asphyxiated newborn.

Concerning the questions of methods by means of which oxygen should be introduced into the circulating blood, and of whether or not it should be used in conjunction with the administration of carbon dioxide there is considerably less agreement.

The administration of carbon dioxide. Selkirk has one man championed a therapeutic measure as strenuously as Yandell Henderson did the use of carbon dioxide for the treatment of depressed respiration and the asphyxias, including asphyxia neonatorum (101 110, 111 112, 117). He stated that carbon dioxide was the physiological respiratory stimulant (99 102 109, 114, 116) in large measure basing his conclusions on the successful use of that agent in the resuscitation of victims of carbon monoxide poisoning (103, 115) and he hypothesized that carbon dioxide produced the muscular tonus he believed necessary for the onset of respirations at birth (108). He justified the administration of carbon dioxide to the asphyxiated newborn, in the face of an already high carbon dioxide tension, on the basis that the respiratory center was so depressed that it was sensitive only to extremely high concentrations of that agent (104 105). He did not fear to induce acidosis by the administration of carbon dioxide in such circumstances, for he did not regard what others called the 'acidotic' condition of the asphyxiated newborn as true 'acid poisoning' (106). A large number of workers have agreed with Henderson that the administration of carbon dioxide is essential in the resuscitation of the asphyxiated newborn and that oxygen alone is merely a food-stuff, not a respiratory stimulant (10, 52, 72, 73, 83 84, 85, 128 136 185, 202). Henderson and supporters of his thesis believe that 93 per cent oxygen with 7 per cent carbon dioxide is the ideal mixture of gases for routine use in resuscitation (3 17 34, 35 137 146, 149, 152, 154, 155, 219, 229). In the presence of profound asphyxia, and in the hands of experienced workers, however, it has been advocated in the past that up to 30 per cent carbon dioxide be employed (159, 151 103, 243).

Carbon dioxide may be of use as a stimulant when respirations become depressed during the first days of life (46 118 218) but there are now a number of reasons for believing that its use cannot be justified in the treatment of asphyxia neonatorum. Eastman could find no correlation

The use of stimulatory drugs Epinephrine given intracardially has been advocated for cardiac failure occurring in asphyxia neonatorum (52 149, 156 166) and some remarkable recoveries have been attributed to its use (235). It is now recognized however that epinephrine frequently precipitates ventricular fibrillation (56 140) and its use is therefore contraindicated.

Alpha lobeline has been reported to be of immense value for initiating respirations in the newborn by Wilson and his coworkers (241 242 243) as well as others (52 137 193 203). Careful studies of the drug however have revealed that its respiratory stimulative properties are variable in occurrence temporary in duration associated with cardiac depressant properties, and appear only in doses that are at convulsant levels (37 45 85 118 126 147 152 167 236).

Pituitrin, camphor coramine, picrotoxin, me trazol caffeine, and strychnine have all been used as stimulants in the treatment of asphyxia neonatorum (149 153 154 155 166) but they are capable of doing more harm than good (1 11 56 70, 132 135, 147 218 230). These so-called stimulatory drugs are not selective stimulators of the respiratory and vasomotor centers rather they stimulate those centers in the course of their action as generalized cerebral stimulators (91). Davis and his coworkers (48) found that the oxygen tension of the cat's brain fell to low levels during convulsions produced by such drugs. Since it had been shown previously that there was no change in the cerebral circulation before or during an induced seizure (88 89, 121 172) they interpreted their work as indicating that this relative anoxia was caused by increased cerebral metabolism. Schmidt and his coworkers (199) confirmed this work in the monkey they found that the cerebral oxygen uptake invariably changed in the same direction as the cerebral functional activity and that the highest levels of cerebral oxygen uptake were produced by convulsant drugs. The use of such drugs was often followed by a more severe depression than that which it was intended to overcome and recovery from the effects of cerebral depressants occurred distinctly more rapidly when no analeptic was given. These studies led Schmidt to question the use of stimulatory drugs in the treatment of cerebral anoxia, since they raise the demand for oxygen beyond the available supply (198). He even suggests the cautious use of cerebral depressants in certain situations of cerebral anoxia. Kety's method for the quantitative determination of cerebral blood flow and metabolism in man will undoubtedly be applied to this problem and in time we may

even have measurements of the oxygen consumption of the asphyxiated newborn before and after the use of stimulatory drugs. Until that time however it would appear from the experimental evidence that the use of these drugs is of questionable value, and may even be definitely harmful.

The enzymatic compound cytochrome C has been shown to be useful in combating certain types of anoxia in man (180) but as yet it has had an insufficient trial as a therapeutic agent in the problem of asphyxia neonatorum.

SUMMARY

1. Intrauterine respiratory activity of the fetus does occur whether this occurs normally as the physiological forerunner of postnatal respiration, or only under abnormal conditions, has not yet been determined.

2. Asphyxia neonatorum is a generic term used to describe lack of oxygen of varying severity occurring in the newborn infant. The etiological factors of this syndrome include the age of the mother the parity of the mother the health of the mother the viability of the germ plasma the immaturity of the infant, the presentation and position of the fetus the medical induction of labor the duration and type of labor the complications of labor the type of delivery the analgesic drugs employed, and the anesthetic agents and methods employed. Chemically the syndrome is characterized by a decrease in content of oxygen in the fetal blood a secondary increase in the tension of carbon dioxide an increase in the content of lactic acid, and a decrease in the pH of the fetal blood. The primary pathological lesion of asphyxia neonatorum is atelectasis of the lungs secondary pathological lesions result from anoxia. Permanent irreparable damage of the central nervous system may result from the anoxia of asphyxia neonatorum.

3. The establishment and maintenance of an airway is the first requirement in resuscitating the asphyxiated newborn. This may be followed by extremely gentle external stimulation. Oxygen must then be administered, by a form of artificial respiration, if necessary. Carbon dioxide should not be used in conjunction with the administration of oxygen. Warmth should be maintained throughout the resuscitative period and thereafter. Stimulatory drugs may do more harm than good and should not be used.

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tage of requiring periods of steep Trendelenburg position, which may initiate or aggravate the complication of intracranial hemorrhage.

Respirators of the Drinker type (58 60) adapted in size to infants (38 53 59, 107) induce a negative intrapleural pressure by subjecting the external thoracic cage to a negative pressure equal to 10 centimeters of water. Those who advocate their use point out that while such respirators may not actually initiate respirations, they will maintain oxygenation and life in the most physiological manner yet devised until spontaneous respirations occur (34, 42 84 110 118 155 160, 162 164, 165 181). However studies of the lungs of infants so treated but who have come to autopsy have shown that very little pulmonary aeration has occurred with the use of such low pressures (17 94, 136, 243) and yet that, at times, gross pulmonary damage has been done (50). It has also been emphasized that it is extremely difficult to regulate the rate and rhythm of the respirator to the irregular respirations of the asphyxiated infant when respiratory efforts finally do begin; thus, they may become completely inhibited altogether (152).

Mouth-to-mouth insufflation is the simplest method of intermittently increasing the pressure in the alveolar spaces, and this method may also be used alternately to increase and decrease that pressure. The mouth-to-mouth method has been warmly recommended as an immediately available way of supplying at least some oxygen (5 34, 35 55 73 82 128 149 154, 155 228, 229 237) but even its advocates warn that there is a great danger of creating an excessive intrapleural pressure and thus causing fatal emphysema and pneumothorax (12 34, 50, 73 75 118 137 152 203 218 243). Unless intratracheal intubation has been performed, there is also the danger of overdistending the stomach and rupturing it (17 243) although this danger may be mitigated by the use of gentle pressure on the epigastrium. Finally there is the danger of infection, both to the infant and in diseases such as congenital syphilis, to the operator (12 185 243).

Another method of intermittently increasing the pressure in the alveolar spaces is by the use of a face mask and an inhalator such as the Kreiselman resuscitator (127 130 131 161 228 232). This machine is designed to supply intermittent flows of oxygen under positive pressure at a maximum value that can be controlled by the operator although this value is usually never above 15 or 16 millimeters of mercury. Pulmonary damage is unlikely although it may occur at such pressures but pulmonary expansion is also unlikely at such

pressures, although it too may occur (17 203). As with other methods employing positive pressure, there is the danger of distending the stomach.

Resuscitators that provide alternate increase and decrease of the pressure in the alveolar spaces such as the Erickson and Johnson resuscitator (34 40 171) have been both recommended (13, 114 148, 191 192, 193 218, 231) and condemned (5, 136 169, 230). The objections to the "suck-and-blow" resuscitators are the dangers of pulmonary damage from both positive and negative pressures (110 113 152) the danger of overinflating the stomach (152) the fact that such machines frequently become mechanically defective at the critical moment (84 100) and the fact that such machines may adapt to slight obstructions in the airway rather than to the volume of the lungs of the newborn (117 152). However a number of other workers employing these machines have been able to demonstrate no injurious effects on the lungs (148 152 181 191, 231). The experiments of Thompson and Birnbaum, wherein they effected the resuscitation of asphyxiated dogs by using 100 per cent nitrogen and other physiologically inert gases, with this so-called "suck-and-blow" method, are worthy of comment (14, 15 35 221 222 223, 224). By the use of nitrogen in a "suck-and-blow" resuscitator they could reverse a larger percentage of asphyxiated animals than by the use of oxygen with manual artificial respiration (221 223). It is the belief of Thompson and Birnbaum that deflation initiates powerful stimulatory impulses for respiration which travel over the vagus (15 35, 222) and which can not be elicited by inflation alone. Reicher has confirmed their work. More recently Thompson and his co-workers have injected radioactive sodium into the femoral veins of asphyxiated dogs and have demonstrated a greater circulatory movement with "suck-and-blow" resuscitation than with other methods of artificial respiration (225). They repeated this work, using oxygen as the tracer (226), but the findings were still at variance with those of other workers (57 231).

The maintenance of warmth. The majority of workers are agreed that in asphyxia neonatorum the warmth of the body should be maintained by blankets, tub or incubator. The recent concept that heat, by increasing the metabolism, may increase shock and therefore be contraindicated in the presence of shock has not yet been applied to the problem of the asphyxiated newborn. It is interesting to note in this connection however that a decrease in temperature was shown experimentally to be an important factor in aiding the survival of anoxic newborn puppies and rats (81).

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Seborrheic Blepharitis and Conjunctivitis. JOSEPH S. GOTZ, PHILLIPS THYNGSTON and MORRIS WATSMAN. *Am. J. Ophth.* 1947 30 1485

The authors report their observations on Pityrosporum ovale in seborrheic blepharitis and conjunctivitis. Except when secondarily infected seborrheic dermatitis of the eyelids is a mild almost symptomless disease. However some cases are associated with acute conjunctivitis and keratitis. Although pityrosporum ovale is the only constant bacteriologic finding in the disease its rôle in this condition is unsettled because seborrheic dermatitis does not occur in animals and animal inoculations fail to reproduce the disease. Moreover the few recorded human inoculations with this unclassified yeastlike organism have been inconclusive, so that it is difficult to determine whether the organism occurs as a saprophytic or as an etiologic agent. It was found in scrapings from 100 per cent of 143 cases of clinically recognizable seborrheic dermatitis of the eyebrows and eyelids—in moderate numbers in mild cases and in enormous numbers in severe cases. Skin tests with extract of Pityrosporum ovale in 16 individuals without gross seborrheic blepharitis or dermatitis of the scalp resulted in questionable or negative reactions but in 5 of 46 individuals with seborrheic dermatitis of the eyelids the resultant skin reactions were significant. Three of these 5 patients developed severe lesions of the conjunctiva and cornea.

It is concluded that although no conclusive evidence was found that Pityrosporum ovale was pathogenic for the eye and its adnexa, its etiologic relationship is suggested by the following findings: the constant presence of the organism in the lesions; the relationship between the number of organisms and the severity of the disease; the relative absence of the organism in clinically normal eyes; the inability of the organism to grow on any but complex culture media (saprophytes grow on simple media) and the sensitization to the organism revealed by intra-dermal skin tests. JOSEPH S. GOTZ, PHILLIPS THYNGSTON and MORRIS WATSMAN. *Am. J. Ophth.* 1947 30 1485

Intraepithelial Epithelioma. BENJAMIN ESTERMAN, JOSEPH LAYAL, and CLARA OKRAJNYL. *Am. J. Ophth.* 1947 30 1537

The authors report a case of intraepithelial epithelioma of the cornea and conjunctiva (Bowen's disease). Only 7 cases have been reported in the literature.

In all cases complete surgical excision was always considered the treatment of choice (although the difficulties of complete excision were mentioned in

1 case). Radiotherapy has not been advocated and some pathologists are even of the opinion that it is contraindicated. In 1 case treated by radiation there was no recurrence during the remaining 4 years of the patient's life.

In the present case report the condition occurred in the right eye of a woman 63 years of age. The vision which was 10/200 could not be improved. The tumor situated at the lower nasal quadrant of the limbus presented a pinkish gray granular appearance about 5 mm. in diameter. The mass was slightly elevated and had the texture of a cauliflower. There was a faint grayish infiltrate in the cornea and local congestion of the bulbar conjunctiva and episclera.

It was decided to treat the patient by radiation. Nine treatments of low voltage unfiltered x ray therapy were administered in fractionated doses of 600 roentgens every other day up to a total of 5,400 roentgens in 18 days. At the end of this course of treatment the tumor had disappeared entirely leaving only a faint infiltrate a few small deep vessels and a very shallow depression at the site of the growth. JOSEPH S. GOTZ, PHILLIPS THYNGSTON and MORRIS WATSMAN. *Am. J. Ophth.* 1947 30 1485

A Consideration of Aniridia with a Pedigree. P. H. BEATTIE. *Brit. J. Ophth.* 1947 31 649.

The author discusses aniridia with a pedigree. This congenital anomaly was treated in 2 or 3 patients of a family and their various blood relatives were visited to observe and record the condition of their eyes.

Thirty-one patients were found with bilateral abnormalities of the iris. 4 patients had coloboma of the iris with or without hypoplasia of the iris. 10 presented either partial or complete aniridia of both eyes and 12 presented bilateral aniridia and ectopia lentis.

Three clinical types of cases have been described. 1. Patients with coloboma and/or hypoplasia of the iris. These patients have no disability; their visual acuity is normal and they show no tendency toward the formation of lens opacities nor toward increase of their intraocular pressure.

2. Patients with simple aniridia. They present photophobia and poor vision. They develop scattered opacities and deterioration in vision as they grow older.

3. Patients with aniridia and ectopia lentis. These patients present photophobia and their visual acuity is poorer than that of patients with uncomplicated aniridia.

Only affected members of the family transmit the disease while normal children invariably have normal offspring. It is a dominant characteristic in

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ml indicated that significant lasting impairment may extend to brightness levels of 50 ml or less.

4. All patients showed a temporary impairment in acuity and in brightness sensitivity at 2 ml after previous adaptation to 2000 ml. None showed lasting impairment after adaptation to the low brightness.

5. Impairment in foveal sensitivity to flicker at high intensities was less marked when the brightness of the surrounding fields was 1 ml and only the 1 degree test field was of high brightness.

6. Increase in the length of the dark phase of the flicker cycle produced less than the normal increase in sensitivity to flicker at the fovea. This was true at low as well as at high brightnesses of the test field.

7. The findings in patients studied for more than 3 months while on tridione indicate that tolerance to the visual side effects develops with continued medication. Patients reexamined after the drug was discontinued showed no evidence of any visual impairment after 10 weeks without tridione.

The action of tridione on the visual mechanism probably does not occur posterior to the chiasm since exposure of one eye to a high brightness does not produce these effects in the unexposed eye. If the action were at the level of the optic nerve it is unlikely that cone fibers alone would be affected. It seems probable, therefore, that the drug produces its effects at the retinal level. For the most part the phenomena suggest that the neural layers of the retina rather than the photochemical processes are involved. Studies on animals of the effects of tridione use of the electroretinogram measuring the optic nerve discharges and so forth might therefore be of aid in explaining the mechanism of the visual defects.

J. WOODHULL OVERTON M.D.

Disseminated Lupus Erythematosus FREDRICK C. CORDON and SAMUEL D. AITKEN Am. J. Ophth. 1947 30 1547

The authors report the ophthalmoscopic findings in a case of acute disseminated lupus erythematosus in a woman 36 years of age. The patient was observed clinically for a period of 6 months before fatal termination.

Examination revealed the presence of cotton wool like exudates with small irregular and flame-shaped hemorrhages. The disk was edematous. The vascular changes were most striking: the veins were dilated and irregular in caliber and associated with perivascular thickening and with small isolated thrombooses; the arterioles presented a spotty and disseminated distribution of markedly irregular localized narrowings, some occlusion perivascular thickenings and arteriosclerosis.

Microscopic examination revealed exudates, subintimal thickening and sclerosis of the arteriolar and arterial walls with narrowing of the lumina and wide spread vascular occlusive lesions. Intimal endothelial changes were absent.

No single lesion or combination of lesions is considered pathognomonic of lupus erythematosus. Toxic retinitis is the most typical picture.

General manifestations of the disease include, in addition to the lesions in the skin a prolonged low grade fever which fluctuates irregularly changes in the endocardium renal involvement leucopenia anemia loss of weight asthenia marasmus cachexia, lymphadenopathy hepatomegaly embolic and thrombotic phenomena in the gastrointestinal tract, pulmonary infections arthritis and arthralgia, ulcerative lesions of the mucous membranes. The disease may affect all age groups and especially women between puberty and the menopause. Its etiology is unknown.

JOSHUA ZUCKERMAN M.D.

EAR

The Nature of the Vestibular Stimulus. L. B. W. JONAKES and J. J. GROEN J. Lar. Otol., Lond. 1946 61 339

The thesis is presented that the vestibular organ distinguishes only between the stimuli of (1) rotational acceleration and (2) linear acceleration and that contrary to commonly accepted interpretations it does not differentiate between dynamic (movement) and static (gravity) stimuli. In support of this view experimental data is given to show that all types of linear acceleration (gravity centrifugal force accelerated linear movements) create the same qualitative and quantitative response in humans. There are two different organs analyzing these stimuli in the vestibular apparatus. This observation is confirmed by (1) the power of discrimination of linear and angular acceleration which persists after destruction of one labyrinth and (2) the striking difference in indication time and after sensation when angular and linear stimuli are separately measured. The indication time is the length of time required for the sensation of either rotary or linear acceleration to reach a maximum.

JOHN R. LINDRAY M.D.

Healing of Experimental Labyrinthine Fistulae: Further Observations J. R. LINDRAY Arch. Otol. Chlc. 1947 46 584

The present report is a continuation of one made a year earlier and the various factors influencing osteogenic closure of a labyrinthine fistula are discussed. The author states that success in preventing osteogenic closure depends on a number of factors. Removal of bone dust and endosteum was essential since these could not be separated in the mastoid cavity, or one in which the covering graft degenerated always closed, usually within 2 to 3 weeks. In all fenestras which had been kept open permanently there was found a thin fibrous attachment while in those developing osteogenic closure, a thick layer of fibrous connective tissue was observed between the canal and the flap in which bone was irregularly being laid down. In no case was an open fistula maintained in the monkey unless the membranous labyrinth was present and closely united to the flap or graft.

herited from affected members of a family in approximately 50 per cent of the cases. Although the condition is not accompanied by any skeletal abnormalities, such as those associated with congenital dislocation of the lens (arachnoidecty) the following defects were encountered in the family: excessive fat, a lazy good humored temperament (suggestive of pituitary dysfunction) and a physiologically small type of sella.

Treatment depends on the type of case. No treatment is required for patients with colobomas and/or hypoplasia.

In cases of aniridia the photophobia may be relieved by wearing dark glasses by contact lenses designed with an artificial iris and a central pupil of normal size, or by tattooing of the cornea to eliminate peripheral rays of light. If glaucoma develops trephining may be performed to relieve it however it is not generally effective. Eyes with aniridia have a predisposition to early lens changes.

For the patients with aniridia associated with ectopia lentis photophobia may be relieved by wearing dark glasses and vision may be improved by correction of the error of refraction.

The author concludes that it is the ectopia lentis associated with the aniridia that is responsible for the high percentage of glaucoma in this series of cases. To prevent the possible development of glaucoma needling rather than the more hazardous procedure of removing the lens (extraction) is advocated in the hope of accomplishing rapid absorption of the lens. If the tension becomes elevated after absorption a trephine operation should be performed.

JOSEPH ZOCCERMAN M.D.

Transplantation of the Vitreous. S. MUKL GARTNER and BAURO S. PRITTSKY. *Arch Ophthalmol* 1947; 38: 487

It has been found that the human eye can tolerate the removal of up to 0.6 c.c. of vitreous without apparent damage. The authors experimenting on young albino rabbits, studied the amount of vitreous removal that was feasible as well as the transplantation of vitreous and its substitutes.

They found that simple withdrawal of 0.3 c.c. produced only a transient conjunctival flush however withdrawal of 0.4 c.c. or more of vitreous produced hemorrhages on the iris and retina and sometimes in the vitreous with disastrous final results. Histological examination of eyes from which 0.9 c.c. of vitreous had been withdrawn showed extremely dilated intraocular vessels with extensive hemorrhages into the various structures and spaces of the eye. Removal of vitreous which was immediately replaced by other vitreous still caused degenerative changes. However by the device of a double needle and syringe which could remove old vitreous and inject new vitreous simultaneously little hypotony was produced and the procedure was well tolerated.

The best substitute for vitreous was vitreous from another eye (rabbit kitten or human being) and amounts up to 1 c.c. were successfully transplanted.

Saline solution could be substituted in small cases. A blood vitreous mixture was withdrawn with in a vitreous transplantation within 4 hours after its injection. If the blood remained several days it coagulated and could not be withdrawn. Vitreous preserved under refrigeration for a week became cloudy but could be injected without undue trouble.

ROBERT H. JOHNSON, M.D.

Visual Effects of Tridione. LOUISE L. SMITH and ANITA P. GILCHRIST. *Am. J. Ophthalmol* 1947; 30: 154

A new synthetic compound, "tridione," has recently been used as an anticonvulsant in the treatment of epilepsy. A number of papers describing the results obtained with this new drug mention the fact that patients frequently complain of visual symptoms associated primarily with high blood levels. Such symptoms are reported by a majority of adults and adolescents, only occasionally by younger children.

The purpose of this paper is to report the results of a series of tests of visual functions which provide further information as to the nature of the usual visual phenomena associated with tridione therapy.

Tests of the visual function were made prior to and two brightness levels, 2 millilamberts and 2,000 millilamberts, and emphasis was placed on measurements of the rate of recovery of visual function after continued exposure to each brightness level. Tests of both visual acuity and differential brightness sensitivity at the fovea were used in the experiments. Supplementary studies included determination of the light threshold tests of color discrimination at high intensity and tests of sensitivity to flicker.

The dosage of tridione was 2 gm. per day in 1 case, and 3 gm. per day in 1 case. The studies were from 2 to 9 months.

The significant effects of tridione on visual function demonstrated in this study may be summarized as follows:

1. Acuity brightness sensitivity color discrimination and sensitivity to flicker showed temporary impairment in all patients tested when both the foveal test field and a surrounding area of 6 to 10 degrees were illuminated to a high brightness. While these findings all point toward impairment in function of the foveal cones at high brightnesses, supplementary tests indicated that the defect was not a localized central scotoma, but involved cone function throughout the entire retina.

2. With continued exposure to the high brightness there was gradual improvement in visual function. In 5 of 7 patients, acuity and brightness discrimination reached normal values after about 10 minutes. Sensitivity to flicker although it improved, continued to show significant impairment after long adaptation to the high brightness in patients who had recovered normal acuity and normal brightness sensitivity.

3. Two of the 7 patients showed a lasting impairment of both acuity and brightness sensitivity at 2,000 ml. Tests of acuity at brightness below 2,000

Advanced age a poor general condition repeated operative failures and aplasia of the palate form contraindications to operation. In cases presenting these factors modern prostheses furnish excellent results. The author favors relatively large instruments. He uses nonabsorbable suture material such as nylon or cotton. Whenever deep anesthesia is not required local and block anesthesia is employed. Anterior and posterior palatine branches are injected and the staphylopharyngeus mucosa is infiltrated with the anesthetic. For general anesthesia the author uses ether and oxygen employing intratracheal intubation. Morphine and atropine are given preoperatively. The patient is operated on in Rose's position.

The operative technique is based on the mobilization of mucoperiosteal and muscular flaps.

Success depends on gentle handling of the tissues, complete dissection of the flaps and proper immobilization of sufficient duration. Long lateral incisions according to Dieffenbach's method with Ernst's prolongations are made. Blair's mucosal sutures in the form of a sagittal U are used. Nasal mucosal muscular and aponeurotic and oral mucosal planes are formed. All adhesences are severed to allow the "push-back."

After the operation an iodoform sponge with balsam of Peru is placed over the wound and is kept in place by means of a molded prosthesis. The latter is attached to the teeth. In infants the prosthesis is kept in place by means of a heavy thread which is carried through the nose and tied over the columella.

JOSEPH K. NARAT, M.D.

Survey of Pathologic Specimens from the Oral Regions Seen at the Army Institute of Pathology during World War II. JOSEPH L. BERKMAN. *Mil Surgeon* 1947 101 363.

Fifteen cases of Ludwig's angina have been recorded which indicates that, although rarely seen the condition remains a problem because of its serious prognosis.

Only 3 cases of Mikulicz's disease were seen. The intensity of infiltration of lymphatic elements was a striking feature. The gland acini become widely separated and atrophic while the ducts undergo hypertrophy in this condition.

Leucoplakia can be classified histologically into two types: (1) the verrucal form, and (2) a leucoplakia which shows less keratotic activity and more widespread involvement. About three-fourths of the lesions reported were on the lips and of these, almost all occurred on the upper lip. Primary syphilitic lesions of the lip may grossly resemble the infiltrating type of carcinoma.

Oral tuberculosis occurs most frequently on the tongue, lips and pharynx in the form of rough, moth-eaten ulcers which may resemble aphthous ulcers and squamous cell carcinoma. Histological differentiation from sarcoid is extremely difficult.

Because of confusion concerning the term epulis, its use has been discontinued. Peripheral giant cell

tumors (giant cell epulis) arise from the periodontal membrane and have a high incidence of recurrence. Granuloma pyogenicum cannot be differentiated histologically from pregnancy tumors of the gums.

Of the 38 salivary gland mixed tumors which occurred on the lips 35 occurred on the upper lip. Eight hundred and twenty-seven squamous cell carcinomas of the lip are recorded; they may be classified into papillary and ulcerating forms. One of every 5 specimens submitted to the Institute was malignant and one of every 8 specimens was a squamous cell carcinoma of the lip. Certain factors peculiar to military existence may be responsible such as excessive radiation, wind, and dust.

JOHN R. LINDSEY, M.D.

Interosseous Wiring in the Treatment of Fractures of the Mandible. STUART GORDON. *Arch. Surg.* 1947 55 660.

Interosseous wiring as a method of treatment in suitable fractures of the mandible has been used by the author in 48 fractures in 46 patients.

Wire suture of the fractured mandible is applicable in fractures of the edentulous mandible fractures having an edentulous posterior fragment, multiple fractures (for stabilization of the main fracture) bilateral fracture through the mental foramina with downward displacement of the central fragments gun (or shell) wounds (for stabilization when a portion is missing) and m fractures at the base of the condyle with displacement. The procedure used by the author is as follows:

An incision is made below the mandibular line. No attempt is made to protect the inframandibular branch of the facial nerve as recovery uniformly has followed its injury. The fracture ends are freed of soft tissue on both surfaces for about 3/4 inch. Two holes are drilled in each end as in Figure 1. A high speed drill should not be used. Twenty six gauge stainless steel wire is threaded through the upper two holes as a simple suture. It is not tightened until the other wire is in place. It was found that some degree of displacement of the posterior fragment recurred if the lower wire was also used as a simple suture. Therefore this wire is placed as a figure 8 with the crossed portion under the edge of the fragment not tending to become displaced. This prevents any postoperative shift. The wires are tightened with the fracture reduced.

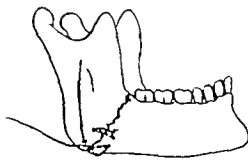


Fig 1 (Gordon)

As it is believed that the least possible movement at a fracture line, particularly when foreign material is present, aids the development of solid union with a minimum of complication. Intraoral fixation was used as well in 43 patients, pins and a Gunning splint in 1 patient each and no secondary fixation was used in the forty-sixth patient.

If a tooth in the line of fracture was rather loose or fractured or had a denuded root in the fracture line, it was extracted before the incision was made. If possible an intraoral dental roentgenogram was taken, since the information obtained from it is of more value than that obtained from a large roentgenogram.

Six of the 48 fractures were simple. Postoperative infection did not develop in any of these. There were 10 postoperative infections in the remaining 42 compound fractures wired. Two of these were serious, resulting in osteomyelitis with sequestration in one case, and union in the other. One of the other 8 infections produced abscesses involving soft tissue only which had to be drained but caused no further damage.

Union occurred in the cases without infection in an average of 44 days. In cases with infection union occurred in an average of 54 days.

In the cases of condylar fracture wiring was done in order to reduce the fracture and to maintain the position. It was thought by the author that the functional result obtained was no better than that obtained from the usual methods of treatment so open reductions were abandoned in this type of fracture.

It was thought from the experience obtained in these cases that the use of interosseous wiring in the treatment of fractures of the mandible was of value in maintaining edentulous fragments in anatomic position in stabilizing a mandible when a portion was missing or when multiple fractures were present and in maintaining accurate reduction of the central fragment when fractures were present in both mental regions, but it was of questionable value in the treatment of fractures of the condylar process. Interosseous wiring makes it possible to obtain and maintain a more accurate reduction of the fracture than that obtained by any other applicable method of therapy. This method should never be used when acute infection is present but its use is not contraindicated in compound fractures free of clinical signs and symptoms of infection. JOHN E. KARASIM, M.D.

Intraosseous Tumors of the Maxilla. H. BLEKHA and H. B. UNGER. *Am. J. Orthodont.*, 1947, 33: 85.

The authors describe 2 intraosseous tumors of the maxilla, and state that tumors of this type are not of common occurrence.

One patient, a 45 year old edentulous female, presented a history of sudden attacks of pain in the right cheek which had been occurring for a period of 3 years. The pain was associated with swelling and "black and blue" discoloration of the face. Physical

examination revealed a hard swelling of the right upper alveolar ridge, extending toward the hard palate. X-ray films showed an osteoporosis of the alveolar ridge of the maxilla and a tentative diagnosis of a localized osteitis fibrosa was made. Following biopsy, a diagnosis of adamantinoma was made. Radical operation consisted of complete removal of the alveolar process and the hard palate on the right side and complete excision of the tumor. The maxillary sinus was not involved. Microscopy established a final diagnosis of adenocarcinoma of mixed tumor type. There had been no recurrence 5 months after the operation.

The second patient was a 16 year old white female who had experienced two attacks of swelling and tenderness of the left cheek and left upper jaw within the preceding year. During one of these attacks an incision was made to evacuate pus. Physical examination showed swelling and tenderness of the left cheek and alveolar process of the mandible. Transillumination revealed a dark antrum on the left side and roentgenograms showed a densely opaque mass within the left maxillary sinus containing several malformed dental structures. A tentative diagnosis of odontoma was made.

At operation the anterior wall of the maxillary sinus was resected and the tumor was removed from the walls of the sinus. The antrum was drained through the nose and the resultant fistula healed within 3 weeks. Microscopy revealed a compound odontoma. X-rays taken 1 month after operation showed a mass within the antrum which apparently was a broken off piece of the original tumor that had blended with the antral wall. The patient was symptom free and roentgenograms taken 6 months later revealed the remnant of odontoma to be somewhat smaller. ELMER D. BLOOMENTHAL, M.D.

NECK

Syndrome of Avellis: A Review of the Literature and Report of a Case. SAMUEL L. FOX and G. B. COOK, JR. *Arch. Otolaryng.*, Chic., 1947, 45: 773.

Since Avellis, a German laryngologist, first published his series of 10 cases of a syndrome which has been given his name in 1891, less than 30 cases have been reported in the available literature.

The syndrome of Avellis comprises a hemiparesis of the larynx and soft palate on the same side and, according to Jackson and Jackson, "there may be loss of pain and temperature sense on the opposite side including the extremities, trunk and neck." This complex syndrome frequently results from a pathologic condition at the jugular foramen although in some of the cases reported it was supposed to be of bulbar origin. Since the vagus nerve is closely associated with its neighboring cranial nerves at this level numerous combinations and modifications are possible and have been described.

To appreciate the syndrome of Avellis fully one should briefly review the anatomy of the vagus nerve

as it emerges from the jugular foramen is accompanied by and contained in the same sheath of dura mater with the accessory nerve and only a fibrous septum separates them from the glossopharyngeal nerve anteriorly. The accessory nerve on making its exit from the jugular foramen separates into a cranial and a spinal portion. The vagus nerve after its exit from the jugular foramen is joined by the cranial portion of the accessory nerve and enlarges into a ganglion swelling called the ganglion nodosum. Through this the fibers of the cranial portion of the accessory nerve pass without interruption and are distributed chiefly to the pharyngeal and are laryngeal branches of the vagus nerve. Thus the pharyngeal branch of the vagus nerve consists principally of filaments of the cranial portion of the accessory nerve. Its branches are joined by branches from the glossopharyngeal sympathetic and external laryngeal nerves to form the pharyngeal plexus. The plexus supplies the muscles of the pharynx and soft palate except the tensor veli palatini which is innervated by a branch of the trigeminal nerve. The external branch of the superior laryngeal branch of the vagus nerve supplies the cricothyroid muscle and gives off branches to the pharyngeal plexus and to the inferior constrictor muscle of the pharynx.

The lesions which may produce the syndrome can be classified etiologically as vascular inflammatory, neoplastic, traumatic, and toxic.

One case is reported because of its apparently unusual causation, i. e. it was secondary to acute mastoiditis. There was complete recovery in this case. Some authors believe it is advisable to discard the term syndrome of Avellis and other similar terms in favor of terms indicative of the site of the lesion. On the basis of this suggestion the case herein reported would be classified as the jugular foramen syndrome.

JOHN F. DELPH, M.D.

Propylthiouracil in the Treatment of Hyperthyroidism. E. PRATT McCULLAGH, RALPH E. HIBBS and ROBERT W. SCHNEIDER. *Am J Med Sc* 1947 314 345.

The authors believe propylthiouracil to be a safe drug for the treatment of hyperthyroidism. No cases of agranulocytosis were seen in 218 patients treated for an average of 8 months and in some instances as long as 14 months. 7 reactions required the cessation of treatment. The action of propylthiouracil is too slow in controlling acute crises in hyperthyroidism and also the hyperthyroidism of acromegaly other all types. Three hundred milligrams per day were found to be an effective dose in more than 95 per cent of the authors' 218 patients. A smaller dose was effective in many and a larger dose was required in less than 4 per cent.

Iodine therapy has been used concurrently with propylthiouracil, and the authors believe that it is definitely indicated as it takes care of some of the symptoms which propylthiouracil does not.

A tentative plan is presented for the use of propylthiouracil with the patients having been graded into four classes.

The first class includes those with small goiters and relatively mild hyperthyroidism.

The second class includes young people with byperthyroidism of mild or moderate degree in which surgery is anticipated thus the iodine is used and acts more rapidly. Propylthiouracil may be used but it is unnecessary.

The third class includes all patients with severe hyperthyroidism, all those over 45 years of age and those with complicating factors such as a poor cardiac status. For these propylthiouracil is used and when the disease is controlled Lugol's solution is administered.

The fourth class includes patients in whom the hyperthyroidism is complicated by extreme old age and cardiac or other complications. For these propylthiouracil may be continued indefinitely. At the present time long continued use of propylthiouracil appears warranted in some patients.

RICHARD J. BENNETT, JR., M.D.

Treatment of Graves Disease with Radioactive Iodine EARLE M. CHAPMAN *West J Surg* 1946 56 47

The author describes the historical background of radioactive isotopes. Hertz, Roberts Evans and others established the physiologic facts for the rational use of radioactive iodine as a single therapeutic agent.

The radioactive iodine used in this series was prepared by the nuclear bombardment of tellurium in

TABLE I—27 PATIENTS TREATED
MAY 1945—MAY 1946

Average dose by mouth	33.6 MC
Average dose retained	20.8 MC
MC—12 hour iodine	
Grams thyroid	estimated 0.81 MC.
MC—12 hour iodine	
Grams thyroid	retained 0.48 MC.

TABLE II—41 PATIENTS RESPONDED TO RADIOACTIVE IODINE 12 DEVELOPED HYPOTHYROIDISM

3 Now taking thyroid
6 B.M.R.—18 to —25
3 B.M.R. gradually back to normal

TABLE III—45 PATIENTS TREATED WITH RADIOACTIVE IODINE

33—Responded to 1 dose
3—Responded to 2 doses
5—Responded to 3 doses
41—Responded
4—Still toxic

the Massachusetts Institute of Technology cyclotron. The principal isotopes used were I^{131} with a half-life of 12 hours, and I^{125} with a half-life of 8 days. The 8 day iodine constituted about one-tenth of the total amount. Approximately 80 per cent of radioactive iodine is absorbed by the thyroid within a few hours after oral administration and most of that not absorbed is rapidly excreted by the kidneys.

Fifty per cent of the total radiation dose from the 12 hour iodine is delivered in the first 12 hours and 90 per cent within 36 hours. The tissue dose per hour is mainly due to the 12 hour isotope for the first 2-5 days thereafter the 8 day isotope adds approximately 2 per cent each day to the total radiation previously delivered by the 12 hour isotope. The basal metabolism rate curves of the 23 patients who responded to a single dose show that the normal basal metabolic rate was reached on an average of 33 days after treatment.

From his experience in treating 45 patients with diffuse goiters and hyperthyroidism the author believes that radioactive iodine with a half life of 12 hours is an effective single therapeutic agent. The possible late toxic effects will have to be observed with the passage of time. Contraindications to its use now seem to be pregnancy beyond the first month and disease of the kidneys.

ERNEST D. BLOOMFELT, M.D.

Two Cases of Tuberculosis of the Thyroid Gland
(Due casi di tubercolosi della ghiandola tiroidea)
GIACOMINO COCCHI. *Arch. ital. chir.* 947 69. 23.

The author reports 2 cases of tuberculous of the thyroid gland. The first patient had a cold abscess which had developed at the bottom of a thyroid adenoma and was secondary to a healed primary pulmonary lesion. Removal of the adenoma and the abscess resulted in a complete cure. In the description of the histologic picture, it was interesting to note the role of the tubercles situated between the follicles, and also the richness of the giant cells.

The second patient had a massive caseous tuberculous of the thyroid gland, corresponding to Lenormant's classification. This focus was secondary to an active focus in the tibia and the tarsus. Extirpation of the thyroid tumor followed by drainage resulted in a cure in 6 months.

In both cases, Koch's bacillus was identified by biological methods.

ARMANDO F. CROCI, M.D.

Cancer of the Thyroid Gland. Anatomical Types, Evolution, and Results of Treatment in 23 Cases
(Cáncer de la glándula tiroidea. Tipos anatómicos, evolución y resultados alejados del tratamiento en treinta y cinco casos)
ANTONIO ECHES and ENRIQUE P. VIACAVA. *Bo. Inst. dta. quim. B. Alir.* 947 3. 24.

From observations on 35 cases of cancer of the thyroid gland the authors hoped that some therapeutic orientation could be adopted on the basis of an anatomoclinical classification. The variability of the patients' clinical physiognomy and the diver-

sity of the histomorphologic aspects attracted some attention. The disparity in the evolution, however, was more significant.

Correlation of the evolution of the disease with the different grades and types was accomplished by means of the strict histomorphologic methods adopted. Three anatomic types were recorded: (1) papillary adenocarcinoma (17 cases), (2) malignant adenoma (11 cases), and (3) anaplastic epithelioma (7 cases of this most malignant condition which manifested itself in the multiple metastases found).

There was no uniformity in the treatment of thyroid carcinoma. In the papillary adenocarcinoma the operation was in direct relation to the grade of the tumor encountered and the invasiveness of the process. In the malignant adenomas, the procedure was limited only by the progress of the neoplasm into the neighboring structures. The cases of anaplastic epithelioma were subjected to little definitive surgery because of the metastatic character of the disease. Block dissection of the tumor and radical resection of the neighboring glands were done in all cases in which this was possible and followed by irradiation therapy.

STEPHEN A. ZIEGLER, M.D.

Modern Trends in Surgery of the Thyroid Gland.
FREDERICK A. BOTTEL. *Surg. Clin. N. America* 947 27. 364.

The diagnosis and treatment of goiter, thyroiditis, and malignancy of the thyroid gland are considered. All cases of goiter are studied preoperatively and are considered from both the physical and laboratory standpoints. Both iodine and thiouracil are believed to be of value in the treatment of hyperthyroidism.

The author presents certain statistics on thiouracil which show that its use in some cases has been disappointing, however, thiouracil has been found to be of definite value in the preoperative preparation of patients with severe hyperthyroidism.

Not infrequently marked disturbances in calcium and phosphorus metabolism occur in hyperthyroidism. Occasionally this (roentgen) finding leads to the diagnosis of hyperthyroidism in cases of long duration with mild or obscure symptoms. Disturbances in carbohydrate metabolism occur in about 80 per cent of patients suffering from hyperthyroidism. Of this number only about 5 per cent have diabetes. When severe diabetes and hyperthyroidism exist it is necessary in about half the cases, to perform a thyroidectomy in two stages. In cases in which foci of infection exist, the operation needed to eradicate the infection should not be performed until from 4 to 6 months after the thyroidectomy. Some of these foci may precipitate severe hyperthyroidism.

Apathetic hyperthyroidism is discussed. In some patients, studies over a long period of time are necessary before an accurate diagnosis can be made. These patients are poor surgical risks, and they require careful, prolonged preoperative preparation, and operation in two stages.

Liver damage and diminished liver function in patients suffering from hyperthyroidism contribute greatly to the surgical risk and operative mortality of thyroidectomy. Studies of liver function are carried out on patients with severe hyperthyroidism or on those who are in crisis. The bromsulphalein and hippuric acid tests are used. These tests serve only as a guide in the treatment of this complication. Routine therapeutic measures which have proved to be of value are intravenous glucose with insulin, bile salts, liver concentrate and glycane.

The optimal time for operation seems to be when the basal metabolism falls to normal or near normal. The determination of blood iodine seems to be more satisfactory in estimating the degree of hyperthyroidism. If the pulse rate remains below 100 hyperthyroidism is usually well under control. If the patient has lost 20 pounds or less he is ready for operation when he has regained one third or more of his weight loss.

The addition of a well trained physician-anesthetist to the operative team has also been helpful in cutting down the mortality of thyroidectomy.

There is approximately a 2 to 3 per cent recurrence of symptoms of all patients operated on for hyperthyroidism.

Hypothyroidism and hypoparathyroidism and their treatment are discussed as well as paralysis of the vocal cords due to injury to the recurrent laryngeal nerves.

Chronic thyroiditis in the form of Riedel's struma and Hashimoto's disease is discussed. Riedel's thyroiditis occurs in either sex, usually in individuals under 40 years of age, while Hashimoto's disease is most always found in women in the later decades of life. The entire thyroid gland is involved in Hashimoto's disease, while in Riedel's struma the process is confined to one lobe in approximately 30 per cent of the cases. In Hashimoto's disease the process does not extend beyond the gland, whereas in Riedel's struma it may break through and extend beyond the capsule. The hardness in Riedel's struma may be very easily mistaken for malignancy. If there is no evidence of malignancy in the microscopic diagnosis of either Riedel's struma or Hashimoto's type of thyroiditis, only one lobe should be removed. In this way hypothyroidism may be postponed.

Acute thyroiditis is usually secondary to acute upper respiratory infection. Occasionally a localized abscess results and this is treated by incision and drainage.

Approximately 90 per cent of carcinomas of the thyroid gland develop in a pre-existing adenoma, thus all adenomas are suspected of being or becoming carcinomatous. Radioactive iodine may be used in two ways—first as a tracer to detect the presence of metastatic lesions by means of the Geiger counter and second to treat malignancy. It has been demonstrated that the radioactive iodine is picked up only by the metastatic lesion in which the tissues are carcinomatous.

RICHARD J. BEDONNET JR., M.D.

The Treatment of Lymph Node Metastases from Intraoral Carcinomas with Special Regard to the Indications for Total Neck Dissection ROLF WEINZ, *Acta radiol. Stockh.*, 1947, 28, 367

The author discusses the published reports of other authors with regard to the treatment of cervical lymph node metastases and presents in detail, the results obtained in the treatment of 386 patients with histologically verified oral carcinoma at the Norwegian Radium Hospital during the 10 year period from 1932 to 1941 inclusive.

Table I shows that 58 per cent of the lesions were in stage 1, 20 per cent were in stage 2 and about 22 per cent were in stage 3.

Broder's method of classification has been adopted. Table 2 shows the number of patients in each group according to the histological examination. The borderline between these groups is not marked but, as will be seen from the table, the greater number of patients (332 or 86 per cent) come into the groups of highly differentiated squamous cell carcinomas.

The method of treatment was as follows. The primary lesion is treated with teletherapy from 1 to 2 fields or more according to the size of the tumor and its situation. After a period of 6 to 8 weeks the lesion is re-examined and if any part of the tumor remains it is coagulated or intubated with radium needles or both. Treatment of the regional lymph node areas commences at the same time that treatment of the primary tumor is instituted. Prophylactic neck dissection is not performed in stage 1 tumors nor is prophylactic neck dissection performed right away in cases in which the lymph nodes are suspected of being cancerous (stage 2). If any part of the tumor still remains after a period of 8 weeks, total neck

TABLE I

	Total	Stage	Stage	Stage
			2	3
Free part of the tongue	84	50 (59.5 per cent)	8	
Base of tongue	6	35 (57.4 per cent)	20	6
Floor of mouth	55	24 (43.6 per cent)	0	
Ca. buccae	60	38 (63.3 per cent)	14	7
Ca. gingivae	66	33 (50 per cent)	20	13
Ca. palati	3	30 (75 per cent)	7	3
Total	286	224 (78 per cent)	78	24

TABLE II.

	Total		1	4
Free part of tongue	84	11	8	8
Base of tongue	6	25	5	4
Floor of mouth	55	24	7	3
Ca. buccae	60	33	4	4
Ca. gingivae	66	48	1	5
Ca. palati	31	31	2	1

TABLE III.—TOTAL NUMBER OF CASES PER CENT OF 3 AND 5 YEAR CURES

Primary lesion	Ca. Linguae anterior 1/3		Ca. Linguae posterior 2/3		Cancer sublingual		Cancer buccae		Cancer glottidis		Cancer palati		Total	
Observation period	3 yrs	5 yrs	3 yrs	5 yrs	3 yrs	5 yrs	3 yrs	5 yrs	3 yrs	5 yrs	3 yrs	5 yrs	3 yrs	5 yrs
Total number of cases	24	67	6	5	23	42	69	36	65	48	31	20	325	398
Dead as result of other causes and without recurrence														
Indeterminate group	3	6		6	4	4	5				7	7		14
Total + Indeterminate + Determinate group	8	61	27	40	23	30	69	31	63	47	44	27	343	376
Dead as result of cancer														
Failures	14	45		30	40		43	35	37	4	23	24	27	207
Free from disease 3 yrs + 5 yrs or more														
Successful results	7	16	5		8	10	15	8	8	6	8	8	64	65
Successful results/ Determinate group	22/8	16/61	5/27	0/40	5/23	2/30	20/69	5/31	8/63	6/47	1/44	8/27		
3 yrs and 5 yrs or more results	31.1%	26.7%	26.2%	1%	24.1%	26.7%	30.3%	26.7%	17%	17%	17%	15%	18.6%	16.5%

dissection is performed. The indications for operation on tumors in stage 3 are subject to greater individual consideration. With increased experience the tendency has been to decrease rather than increase the indications for neck dissection.

The results obtained in the treatment of intraoral carcinomas during the 5 year period are shown in Table 3. Freedom from symptoms has been attained for 5 years in 26 per cent of all cases. 1 carcinoma localized in the free part of the tongue. The main problem in the treatment of intraoral carcinoma is that of treating the primary tumor. Among 203 patients with intraoral carcinoma, 263 died from the effects of the primary tumor, 31 died symptom free, from intercurrent disease, and 8 died as a result of distant metastases without local recurrence. It is suggested that in a great majority of cases the primary tumor is incurable with present methods of treatment. In 234 of 263 patients who died of cancer the primary tumor was found to be a contributory cause of death.

Only 19 patients died of regional lymph node metastases with the primary tumor symptom-free, or probably curable.

A total of 224 patients without lymph node metastases were admitted to the hospital. Later 18 of these patients had operable nodes and 30 had inoperable nodes. Inoperable lymph node metastases developed in less than 33 per cent of these patients. Nine of the patients might have benefited from prophylactic neck dissection. To prove, however, that prophylactic neck dissection was necessary in all 9 cases, it would have been necessary to carry out the procedure in 224 patients.

In the author's opinion prophylactic neck dissection is not indicated in intraoral carcinoma (stage 1) but carcinoma of the tongue calls for special attention.

In stage 2 neck dissection would have had to be performed on 65 patients in order to obtain its possible advantage in 5 recurrences. It is still the prognosis of the primary tumor which decides the fate of the patient. Prophylactic neck dissection is not indicated in stage 3 tumors. The author believes that something further must be done to reduce the mortality from primary tumors. The results presented here are comparable to those obtained in similar series by other authors. RICHARD J. BRONCK, JR., M.D.

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS CRANIAL NERVES

Cerebral Arteriography (Arteriografía cerebral) BAUDE
210 VILLARUYA. *Anales med Méx* 1947 8 15

The author's investigation is confined to arteriography of the internal carotid artery and phlebography. Cerebral arteriography was introduced by Moisés in 1927.

The common carotid artery was pierced after the usual preparation of the skin with tincture of iodine and preliminary administration of morphine and barbiturates. Pentothal sodium intravenous anesthesia was used. The author employs a 17 gauge 10 cm. needle, connected with a manometer and a syringe. An injection of several cubic centimeters of sodium citrate is followed by an injection of from 15 to 20 c.c. of 35 per cent solution of Winthrop's preparation novayin. The author prefers this medium eliminated because the latter is not completely system and is radioactive. The injection is made within 1 or 2 seconds at the most. The first roentgenogram is taken just before the injection is finished and two more pictures are taken in rapid succession 200 ma. and a 36 inch distance are used for taking the pictures.

The main indications for cerebral arteriography are tumors angiomatosis aneurysms arteriosclerosis and thrombosis.

The author reports 6 cases in which cerebral arteriography was employed and proved useful in the diagnosis.

JOSEPH E. NARAT M.D.

The Treatment of Focal Epilepsy by Cortical Excision WILDER PENTFIELD and HARRY STEELMAN
Ann Surg 1947 126 740

Focal epileptic discharge can now be localized in all areas of the cerebral cortex. Excision of partially damaged convolutions adjacent to meningocelebral scars or in areas of brain atrophy has proved to be effective treatment. This is demonstrated in this review of the results of radical surgical therapy of atrophic epileptogenic lesions of the brain of those who were operated upon in the 6 year period from 1939 to 1944. The time of follow up varies from 1 to 7 years.

A total of 76 patients were operated on for epilepsy. Only 1 patient died as a result of the operation his death being caused by an infected extradural hematoma and meningitis. The case mortality was thus 1.3 per cent and the operative mortality 1.3 per cent. Cortical excision was performed in 59 of the 75 cases to be followed up and craniotomy without excision in 16.

A variety of lesions may give rise to cerebral seizures, and brain lesions of many types are apt to produce some local destruction of the nerve cells. After

such destruction neuronal regeneration does not occur in the central nervous system. However unless all circulation to the part is destroyed the neuroglia react in a positive way producing gliosis. Destructive processes are also associated with phagocytosis of myelin and other material. The end result of these changes is gross atrophy of the involved convolutions.

The following pathological lesions are discussed: meningocelebral atrophy, local cortical atrophy, local microgyria, expanding lesions, cysts and other abnormalities. The histologic aspects of the epileptogenic focus are presented.

Patients who suffer from epileptic seizures can be studied by means of a simple classification.

1. *Idiopathic epilepsy*. In this class the electroencephalogram shows a bilateral disturbance in brain potentials of characteristic form. The seizure begins with loss of consciousness and when small is of the type recognizable as absence or petit mal. There is often an epileptic tendency in the families of such patients. For idiopathic epilepsy there is no effective surgical therapy.

2. *Cerebral seizures*. When the attacks are not clearly of the above type the cause should be sought and the pattern of attack studied. If the cause proves to be due to hypoglycemia, a degenerative condition of the brain or systemic disease, surgical therapy is likewise not indicated and the diagnosis is expressed for example as cerebral seizures caused by hypoglycemia.

3. *Focal cerebral seizures*. When the beginning of the seizures is clearly identified and if the cause is obviously not hereditary, metabolic, degenerative, or neoplastic, then the diagnosis of focal cerebral seizures may be made. If conservative treatment does not control the attacks then surgery may be given due consideration. In most cases the patient should be hospitalized for study so that the suitable cases may be selected.

Evaluation of the focal epileptic is also dependent upon the nature of the attack pattern: roentgenography, pneumoencephalography and electroencephalography.

4. *Discussion*. The nature of the operative procedure and excision technique is given and several excellent photographs illustrating the technical features are presented.

Of the 59 patients who had excision 15 had no further attacks from 1 to 7 years after operation while 18 had 1 or 2 seizures but considered themselves cured or practically so, therefore 56 per cent of the patients had a successful operation. Sixteen similar craniotomies were carried out without excision and none of these was successful. It therefore seems logical to conclude that epileptic seizures due to cerebral abnormality are not helped by craniotomy unless radical excision is carried out. Removal

of adhesions, decompression or closure of cranial defects has no effect upon the attacks unless the proper excision is carried out. The elements of success or failure in the excision series are to be sought in an analysis of the nature of the lesion, the methods of study and the technique of removal.

The cause of the original lesion in this series was most often head injury—birth injury and local infection were the second and third most frequent causes. The cause was unknown in 19 per cent of the cases which were subjected to excision and in 65 per cent of those in which the results of explorations were negative. The duration of attacks before operation had little or no influence on the outcome.

It is interesting that when the cause was head injury or infection, the onset of seizures was early. The beginning of attacks in these cases came within 5 years in 4 of 5 cases. On the other hand, when the cause was birth injury the onset of seizures was longer delayed. The beginning of attacks came after the age of 5 in 4 of 5 cases. It would seem therefore, that during infancy and early childhood a damaged brain is usually slower to develop the epileptogenic mechanism than later in life.

Birth injuries gave the best results from excision (76 per cent). Infectious processes came next with success in 56 per cent, and head injuries third with success in 51 per cent. Excision is equally effective when applied to meningocerebral scars or to simple cerebral foci. Removals in the frontal pole were most successful (73 per cent) and those in the central (or sensorimotor) cortex came next (67 per cent).

When attacks recur after operation and after the patient leaves the hospital the earlier they appear the more gloomy is the prognosis of eventual recovery. When attacks occur in the convalescent period while the patient is still in the hospital, the prognosis of a good result is extremely poor if the pattern of onset is the same as before operation. Attacks that indicate a neighboring gyrus is subject to edema or anoxemia will have a different pattern and may produce less pessimism. If the pattern is the same as preoperatively, an immediate second operation should be considered. Six patients were thus subjected to a second excision and 3 of them were placed in the group with successful results.

As a result of this present analysis the authors conclude that the persistence of a "spike" electrographic focus after operation or the appearance of marked delta electrographic activity near the site of removal should cause the surgeon to consider reoperation.

In preoperative studies, the simpler the electrographic record is and the better it is localized the better the prognosis of a successful excision. The more diffuse the electrographic abnormality the less hopeful is the prognosis. It must be added, however, that a well localized simple electroencephalogram, not supported by pneumographic or other evidence of a lesion, has sometimes led to a useless exploration, i.e., a craniotomy without excision. Excision guided solely by an electrographic abnormality seems to be

a procedure of doubtful value. The uses of electroencephalography during operation (electrocorticography) are still being studied and will be reported upon at a later time.

In conclusion, the surest guide to localization of an epileptogenic zone is the seizure pattern. The greatest supplementary help a surgeon can receive is electrographic study by an expert, and this special method of study has opened a new chapter in the treatment of focal epilepsy. However the electrogram without objective change in the cortex and without the other means of study is not yet to be trusted as the final guide to excision.

Radical excision seems to offer a reasonable possibility of cure (56 per cent) to those who have cortical foci of discharge and whose attacks are not controlled by medication. All patients operated upon within a given period have been included in this report, so that the elements of success and failure may become apparent and thus prepare the way for future advance.

HOWARD H. LAMSTER, M.D.

Some Views on the Glioblastomas according to Scherer (*Quelques considérations sur les glioblastomes multiformes au sein du cerveau*) J. DE BUSCHER, *Bruxelles méd.* 947 7-23 1

The author gives a brief summary of the views of the late H. J. Scherer on gliomatous tumors of the brain. He agrees with the report given by Bailey and Cushing on those which arise from below the tentorium but takes exception to their views on concerning the supratentorial gliomas. The supratentorial astrocytoma is believed to be of quite a different nature from the so-called astrocytoma of the subtentorial region; it is diffuse and inclined to malignant deterioration into what he calls a secondary glioblastoma. Scherer attempted to isolate four groups of cerebral astrocytomas: (a) anterior subcallosal, (b) posterior subcallosal, (c) supracallosal, and (d) callosal; this classification is based entirely on their location. The author denies the existence of an astroblastoma and considers that the oligodendroglioma and polar spongioblastoma are not anatomical entities. He has little quarrel with the analysis of the pinal tumors made by Bailey and Cushing. The papillomas of the choroid plexus are included in the ependymomas. As to the vast group of glioblastomas (primary) constituting 50 per cent of the gliomas, he had been unable to analyze these successfully and was still studying them at the time of his death. There is much less difference between the views of Scherer and of Bailey than the tone of the article would lead one to suppose. De Buscher admits that Scherer's classification cannot pretend to embrace the complexity of the facts any more successfully than the scheme of Bailey and pays tribute to the merits of the latter.

The last half of the article is devoted to a logically unrelated discussion of the clinical differential diagnosis of glioblastomas.

The reader would do well to consult the original Volume I of de Buscher and Scherer (Brussels, 1923).

in which Scherer developed his views systematically. It is unfortunate that he did not live to complete the other volumes of the intended trilogy although perhaps not too much is lost. Scherer seems to have delivered his principal message in the first volume. The second volume was to deal with the tumors of the subtentorial region and the analysis of these tumors made by Bailey and Cushing according to detail. The third volume was to deal with the primary glioblastomas concerning which Scherer had been unable to clarify his ideas.

ADRIEN VEX BRUGNON, M.D.

The Role of Pinealomas in the Causation of Diabetes Insipidus. GILBERT HORRAX. *Ann Surg* 1947 125 785.

In this article the author discusses the role of pinealomas in the causation of diabetes insipidus. The occurrence of diabetes insipidus in some patients with pituitary tumors or other lesions in the immediate suprasellar or chiasmal region has been understood since the original investigations on the antidiuretic effect of the secretion of the posterior lobe of the hypophysis by von den Velden and on the causation of diabetes insipidus following lesions of the hypothalamus by Camus and Roussey. On the other hand the occasional report of marked polydipsia and polyuria in patients with tumors arising from the pineal body and apparently confined to this area, which is so far removed from the supposed source of diabetes insipidus, was until recent years unexplainable.

As to the actual intracranial area responsible for polydipsia and polyuria, there were until very recent years three theories, namely, that it was caused (1) by a lesion of the posterior lobe of the pituitary gland, (2) by an injury to the hypothalamus especially the tuber cinereum, and (3) by interruption of a tract of demonstrated nerve fibers running from the hypothalamus through the pituitary stalk to the posterior lobe of the gland, the so-called supraopticohypophyseal tract.

According to Jones it has been shown that there exists a hypothalamohypophyseal system with an included supraopticohypophyseal tract which operates as a functional unit and that injury to any part of this system causes diabetes insipidus. Since secretion of the antidiuretic principle by the pars nervosa (of the pituitary) is dependent on innervation through this tract, the supraopticohypophyseal tract is a functional unit and injury anywhere along this tract may result in diabetes insipidus.

The diagnosis of a pinealoma or a tumor arising from the pineal body has been made in 17 instances in the author's brain tumor series during the past 14 years. In 12 of the patients the tumor was verified histologically either at operation or at autopsy. In the 5 other patients histologic verification has not as yet been possible but in these cases localizing neurological signs combined with the visible ventriculographic evidence of a tumor projecting into the posterior portion of the third ventricle from the

pineal region has certified the diagnosis beyond any reasonable doubt.

Of the total 17 patients 5 have shown well marked diabetes insipidus. Two of these patients were in the group with histologically verified tumors the lesion in the other 3 having been demonstrated by ventriculography. In 1 patient with histologic verification at autopsy the tumor from the pineal region was shown to have extended through the floor of the third ventricle to involve the hypothalamus and pituitary body which explained the presence of the diabetes insipidus. The other patient whose lesion was verified microscopically had a so-called ectopic pinealoma in the area above the sella turcica without clinical or other evidence of a growth in the pineal region. The diabetes insipidus in this patient was of course easily explainable as in other tumors situated in the neighborhood of the pituitary stalk and contiguous structures. The tumor was removed at operation and the patient's polyuria has been greatly decreased.

The 3 patients whose tumors were demonstrated by ventriculography have all had roentgen therapy directed at the pineal region. In 2 of these patients there has been a significant reduction of the fluid intake and output, and excellent control of the residual situation is maintained by the use of extremely small amounts of pitressin powder snuffed up the nose. This improvement may be due to the fact that the area covered by the roentgen treatment included a portion of the anterior third ventricle and hypothalamic region. The 3 other patients still show a rather marked polyuria but both have accustomed themselves to their difficulty. One of them has received further courses of roentgen therapy directed both toward his pineal and suprasellar areas with no appreciable change in his intake and output. Their general condition has remained excellent for from 6½ to 14 years following roentgen therapy. The diabetes insipidus has been considerably relieved in 1 and probably in 2 of these patients. It is possible that the water imbalance may persist because partial interruption of the nerve tract from the hypothalamus to the pituitary is permanent even though the tumor cells originally causing this interruption have been destroyed by the roentgen rays.

The 5 case histories and a discussion of each are reported in detail.

HOWARD H. LAMER, M.D.

SPINAL CORD AND ITS COVERINGS

Streptomycin in the Treatment of Meningitis: Report of 27 Cases Treated at the Boston City Hospital. TOM FITZ PATRICK, RODERICK MURRAY, ALBERT O. SKELLEY, and MAXWELL FINLAND. *Ann Int Med*, 1947 27 494.

Haemophilus influenzae is the most frequent of the gram negative bacilli to cause meningitis and it usually strikes its victims in the first 3 years of life. Of the two types of this organism the smooth encapsulated form is much more important than the rough nonencapsulated one. Of 100 patients reported (by the National Research Council) as hav-

ing been given streptomycin, 17 died. Five of the patients developed a streptomycin resistant strain of *Haemophilus influenzae* while receiving the drug.

Other gram negative organisms which are implicated in meningitis are the *Bacillus coli*, *Alcaligenes faecalis*, *Aerobacter aerogenes*, *Klebsiella pneumoniae*, *Pasteurella tularensis*, *Proteus morgani*, *Proteus vulgaris* and *Pseudomonas aeruginosa*. Streptomycin has been shown to be active in vitro against most of these bacilli and it is effective in experimental infections of animals against some of them. Systemic infections with *Brucella* and *Salmonella* have not responded favorably to streptomycin.

Thirty-two patients with tuberculous meningitis have been treated with streptomycin. Thirteen were still alive at the time of the report, but there was a high incidence of neurologic damage.

At the Boston City Hospital Boston Massachusetts, 7 patients with meningitis were treated with streptomycin. Of 16 who had *Haemophilus influenzae* meningitis, 1 died. Eight had a meningitis due to another gram negative organism and of these, 3 died. Three had tuberculous meningitis and 1 of these died.

Untoward reactions attributed to streptomycin therapy were a secondary febrile episode, increase in protein unassociated with an increase in cells, and a macular erythematous rash.

The authors recommend that the drug be administered both intramuscularly and intrathecally. Adults should receive gm. every 6 hours through the intramuscular route and 50 mgm. daily intrathecally. Children should be given 25 mgm. per pound daily through the intramuscular route and from 10 to 5 mgm. daily intrathecally. Sulfadiazine and penicillin may be given in addition to streptomycin if there is an organism which is sensitive to them.

DANIEL ROCK, M.D.

PERIPHERAL NERVES

Regeneration in the Ulnar Median and Radial Nerves. EDWARD HAMLIN JR. and ARTHUR L. WATKINS. *S. & C. N. America* 947 27 52.

The authors point out the still present fact that surgeons lack a common measurement of what constitutes a satisfactory return of function after injury to a peripheral nerve. In their own group of 248 cases, of which 71 were followed long enough to determine with considerable accuracy the end-result, they considered the result good only if as in the case of either the median or ulnar nerve, there was complete sensory regeneration and sufficient motor regeneration to obviate gross impairment of function. If the radial or peroneal nerves were in question a return of motor function was all that was required for such classification.

They did not observe 100 per cent sensory regeneration following the transection of any nerve yet

of the 271 cases 85 per cent were considered to have had a good result.

The greatest number of injuries were to the ulnar nerve predominately at the wrist. In 7 instances gross sepsis took place following surgery but in these patients good regeneration took place so that the authors feel that sepsis played no part in the poor results, wherever poor results occurred. They did not believe that the age of the patient nor the time interval between date of injury and suture were of any importance in the final result.

In an attempt to determine the rate of growth downward in the ulnar nerve they found the figure to be 1.2 mm. per day as an average in 17 patients with ulnar lesions, with extreme ranges between 3.6 and 58 mm. a day. The same general results were obtained in the patients with median nerve injuries, though clinical recovery was probably not so good as in the patients with ulnar lesions, and the rate of growth in the median nerve was somewhat slower than in the ulnar nerve. The poorest results were obtained in their 36 patients with radial nerve injuries, probably because in this group there were several patients with extensive loss of nerve substance.

So far as technique is concerned they do not depart from the usual standards of careful end-to-end suture with fine suture material through the epineurium after careful trimming of the exposed nerve ends. They place the extremity in a cast for 3 weeks after surgery following which physical therapy is begun. The use of tantalum foil nerve grafts, and the suturing of neuromas with nerve stretching have all failed or have been abandoned by the authors.

A good discussion of electrodiagnostic methods is presented.

JOHN MARSH, M.D.

MISCELLANEOUS

The Carotid Sinus Syndrome: Its Surgical Treatment. RICHARD B. CATTELL and MARK L. WELCH. *Surgery* 947 3 59.

Review of the literature on the carotid sinus syndrome suggests a classification under three headings, according to the efferent pathways over which the impulse travels: (1) vagal characterized by bradycardia, asystole, cardiac arrhythmia and hypotension; (2) depressor manifested by vasodilation and fall in the blood pressure; and (3) cerebral with sudden unconsciousness, unaccompanied by fall in the blood pressure or alteration in the pulse rate.

Three cases of carotid sinus sensitivity are reported in which surgical denervation was performed by stripping the common internal and external carotid sinus "nerves" and removing the inter-carotid tissue. Relief of syncope was obtained by this means in each instance.

EDITH B. FAIRBORTH, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Two Unusual Tumors of the Sternum. THOMAS J KIMBLE, MARK WHITE, and R W KOUBEK
J Thorac Surg 1947 16 640.

Reports of 2 unusual sternal tumors: a benign giant cell tumor and an apparently solitary plasma cell myeloma, are presented and the surgical treatment is outlined. The available literature on benign, malignant and metastatic tumors, and on some of the inflammatory lesions of the sternum is reviewed and tabulated

JOHN J MALONEY MD

TRACHEA, LUNGS, AND PLEURA

Three Cases of Bronchial Hamartoma. One Being an Endobronchial Polyp (Tres nuevas observaciones de hamartoma bronquial uno de ellos poliposo endobronquial) O A IRIE, R I LATIENDA, and A J MURRAY *Rev As med argent* 1947 61 614

This report gives brief data on 3 cases of hamartoma of the lung which were found at autopsy having been asymptomatic during life

Two of the hamartomas were peripheral in the parenchyma of the lung, being located in the lower lobe. The third was found to be almost completely obstructing a secondary segmental bronchus in the left upper lobe. It was pedunculated and believed to arise from bronchial cartilage

All of the hamartomas contained a variety of histologic components including hyaline cartilage, smooth muscle, fat, and elastic fibers. Two of them contained epithelial elements, and the pedunculated one contained bone and bone marrow. They were considered of benign appearance

HERMAN T LANGSTON MD

Recent Advances in Pulmonary Surgery CHARLES PHILMORE BAILEY, FRANK TROPEA, JR., and LAURENCE H. RUBENSTEIN *Surg Clin N America* 1947 27 1373.

Numerous advances in the management of patients with chest injuries were made during the last war

In the treatment of hemothorax, it has been definitely established that early and repeated aspiration without air replacement favors rapid re-expansion of the lung and reduces the incidence of complications. No limit should be placed on the amount of blood removed at each aspiration as much as possible being removed. In the treatment of complicated constrictive pleuritis and suppurative constrictive pleuritis, decortication is an important procedure. Early thoracotomy with complete evacuation of the pleural space, removal of fibrous membrane from the lung surface, complete re-expansion with positive pressure anesthesia and the use of closed suction drainage offers the only possible cure with out multiple operations and protracted convales-

cence. The use of penicillin parenterally and intrapleurally is an important factor in the brilliant results obtained with this procedure.

In bronchiectasis, with well established anatomical changes and associated persistent infection, there is no chance of cure by conservative measures. Surgical removal of the affected bronchopulmonary segments is the only logical and curative therapy

The treatment of lung abscess is carried out in three phases: (1) prevention, (2) treatment of the acute uncomplicated abscess, and (3) treatment of complicated and chronic lung abscess. Prevention includes all measures which forestall bronchial aspiration which is the important cause of lung abscess. It also comprises treatment during the stage of atelectasis and pneumonitis in an attempt to avoid tissue breakdown and cavity formation. Bronchoscopy, postural drainage and antibiotics and sulfonamides have their greatest value in this stage. In acute uncomplicated abscess (less than 2 months old and consisting of a single cavity) bronchoscopy, postural drainage and antibiotics may be of value. Should no improvement occur, rib resection and cavectomy should be performed promptly. In the establishment of surgical drainage, the abscess should be localized and should be entered without traversing of the free pleural space. Drainage should be established through the area of adherence of the lung and chest wall. In complicated and chronic abscesses more than 2 months old with multiple cavities, atelectasis of the involved region and residual pneumonitis, pulmonary resection offers the best means of cure. Transfusions, antibiotics and conservative drainage are of great value in the preoperative preparation of the patients.

In addition to the general conservative treatment of pulmonary tuberculosis, the surgical methods employed are collapse therapy, drainage and excision. Artificial pneumothorax is the most commonly used collapse measure. However, maintenance of an effective pneumothorax (one which does not close cavities) beyond a trial period of from 6 to 8 weeks is a questionable practice unless adjuvant measures, such as open pneumolysis, phrenic paralysis, and pneumopneumothorax, are used. Advanced endobronchial tuberculosis of the major bronchi is a contraindication to artificial pneumothorax as the partially obstructed bronchus may become completely obstructed after pneumothorax collapse. In the case of tension cavities, pneumothorax often results in an enlargement of the cavity.

With the increasing safety of resection, thoracoplasty will probably be used more and more for early thin-walled cavities of the upper lobe. The effectiveness of phrenic nerve operations is difficult to evaluate.

Drainage operations (open cavernostomy and closed catheter drainage) are occasionally performed. Cav-

ernostomy has been repeatedly tried and discarded. It is sometimes done as a preliminary operation to thoracoplasty when the patient has a tension cavity or a very large cavity which may resist simple thoracoplastic collapse. Monaldi's closed cavity drainage is used sometimes in the treatment of very large and tension cavities and as an adjuvant to thoracoplasty in these types of cases.

The most classical indication for resection in pulmonary tuberculosis is severe bronchial stenosis with retention of secretions distal to it. Other indications are tuberculoma, check valve or tension cavities, very large cavities, hilar cavities, lower lobe cavities in which pneumothorax is ineffective, bronchiectasis residual to tuberculous infection with persistent positive sputum, cavities which have resisted anatomically adequate collapse therapy (usually thoracoplasty), bronchopleural fistula with mixed tuberculous empyema, and a destroyed lung.

The contraindications to operation in bronchogenic carcinoma are metastases to distant parts or to a nearby part which cannot be resected. Marked distension of the neck veins, indicative of serious superior vena cava obstruction, and the presence of a very copious purulent expectoration in cases which are likely to be inoperable from other evidence, are almost contraindications to even a simple exploration.

Whenever feasible pneumonectomy is the operation of choice for bronchogenic carcinoma. When it is impossible to obtain a cure because of intrathoracic extension, and yet it is possible to remove the primary lesion by lobectomy or pneumonectomy, palliative resection is a valuable measure. Surely the removal of an obstructed, suppurating lung along with the primary lesion cannot but improve the patient's general condition. Following pneumonectomy thoracoplasty is done when the patient appears to have been cured, and when he is vigorous enough to tolerate the procedure without risk.

SAMUEL KAHN, M.D.

HEART AND PERICARDIUM

Physiological Studies in Congenital Heart Disease: Measurements of the Circulation in 5 Selected Cases. L. D. VANDAM, R. J. BING, and F. D. GRAY, JR. *Bull Johns Hopkins Hosp* 947: 8, 92.

The authors chose 5 selected cases to illustrate the diagnostic value of physiological studies when applied to a variety of clinical problems dealing with congenital heart disease. The preceding articles of this series have been concerned with procedures employed and studies of circulatory measurements of the tetralogy of Fallot and of Eisenmenger's complex. Most of the data were obtained by applying the Fick principle. Blood gas values substituted in the Fick equation were obtained by catheterization of the heart chambers and great vessels by arterial puncture, and by analysis of the respiratory gases.

At postmortem examination the first patient showed a heart which functioned as though it had

a single auricle, because of a patent foramen ovale and a 3 cm. articular septal defect. The left ventricle gave rise to the pulmonary artery and most of the aorta since it straddled a 4 cm. defect in the interventricular septum. The blood flows from the pulmonary capillaries and pulmonary artery were reduced to 1,480 and 1,900 c.c. respectively and of these amounts slightly more than half was venous blood, the predominating direction of the intracardiac shunt was right to left and the peripheral blood oxygen saturation was 69 per cent. The oxygen content of the blood from the ventricles corresponded closely to that of the peripheral blood, which suggested a single ventricular compartment.

The second patient presented the tetralogy of Fallot. The pulmonary capillary blood flow was reduced to 3,390 c.c. The right ventricular blood was found to be 3.6 volumes per cent higher in oxygen content than the blood from the auricle. The pulmonary artery and effective pulmonary blood flows were 1,500 c.c. and 1,935 c.c. respectively. The collateral blood flow to the lungs was 800 c.c. and the intracardiac shunt directed from right to left was 200 c.c. The systemic blood flow was 1,850 c.c.

The third patient had a large patent ductus. The data accumulated before operation indicated a left to right extracardiac shunt. However there was some indication of right to left shunting in the results obtained with peripheral oxygen saturation tests.

The fourth patient had a patent foramen ovale and stenosis of the pulmonary valve. Results of catheterization and exercise tests showed evidence of a reduction in the pulmonary artery blood flow, a reduction in the effective blood flow to the lungs, and the probable presence of an intracardiac shunt. Elevated intraventricular pressure on the right side and a reduction in pulmonary artery pressure indicated pulmonary stenosis.

The fifth patient had a very small pulmonary artery with a large collateral circulation to the lungs. In spite of fluoroscopic findings of a prominent pulmonary conus, increased lung markings, and pulsations in the lung fields, a diagnosis of pulmonary stenosis could be made following performance of exercise tests and catheterization of the right ventricle.

W. FOSTER MONTGOMERY, M.D.

Wounds of the Heart; 9 Cases (Ferimentos do coração; comentários sobre 9 casos). R. FERREIRA SANTOS, A. DIAS DE ALMEIDA, and F. C. SILVA TELLES. *Rev Hosp Clin*, 947: 2, 95.

The authors review their experience derived from managing 9 cases of cardiac wounds seen in a 3 year period at the Serviço de Pronto Socorro do Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo, Brazil.

The symptomatology and clinical picture are reviewed in some detail, with emphasis on the two principal types of wounds: (1) that produced by cardiac tomopuncture and (2) that produced by hemorrhage (hemothorax or external bleeding). An injury occurring within the danger zone of Ziegler (a quadri-

lateral space between the right parasternal and left anterior axillary lines and the angle of Louis above to the level of the tenth rib below) should be carefully watched for evidence of cardiac involvement.

The authors favor surgical intervention instead of more conservative management because of the delayed complications which occur in apparently controlled cases. The operative approach they used was either a median sternum-splitting incision or a thoracotomy at the left fifth intercostal space.

There were 5 deaths among the 9 cases. Seven patients were operated upon with 3 deaths. The 9 case histories are given in fairly ample detail.

Numerous diagrams, photographs and semidia phragmatic charts illustrate the text. Thirty-six bibliographical references are appended.

HERMAN T. LANGSTON, M.D.

ESOPHAGUS AND MEDIASTINUM

Esophageal Varices. HERMAN J. MOERSCH, *J. Am. M. Ass.*, 1947 135 754.

The results of treatment in 22 cases of esophageal varices in which gastrointestinal hemorrhages occurred are reported. In these cases the patients were treated by the injection of a sclerosing solution into the varices through the esophagoscope. At the time the study was made 12 of the patients had had no further bleeding after treatment, all 12 had gone longer than 3 years without bleeding, and 8 had gone more than 4 years without bleeding.

Patients in whom satisfactory results were not obtained by injection of a sclerosing solution invariably were found to have varices in the cardiac end of the stomach as well as in the esophagus, which was not true in the successfully treated cases.

Röntgenologic examination is of great value in the diagnosis of esophageal varices but is not infallible. In doubtful cases esophagoscopy should be employed.

In cases of varices in which the cardiac end of the stomach as well as the esophagus is involved some form of treatment other than that of injection of a sclerosing solution, such as portal caval anastomosis or resection of the cardiac end of the stomach and lower end of the esophagus, should be considered. The authors thought that such an alternate form of treatment eventually may even become the procedure of choice in uncomplicated cases of esophageal varices.

Clinical and Radiologic Features of Lymphatic Metastases in Carcinoma of the Thoracic Esophagus (Estudio clínico y radiológico sobre las adenopatías neoplásicas del cáncer del esófago torácico) J. HORACIO REZANO, *Boletín Soc. cir. Uruguay*, 1947 18 101.

Radical surgery for cancer has two objectives: extirpation of the tumor and removal of its metastatic field. In the case of cancer of the esophagus, the accomplishment of these objectives is difficult because of two anatomical characteristics of this organ: (1) a

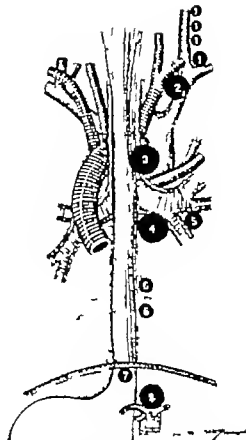


Fig. 1. (Rezano) Metastatic field of esophageal carcinoma which was found to be involved most frequently: (1) the jugular chain, (2) the node situated at the origin of the right subclavian artery, (3) the right paratracheal node, (4) the subcortical or tracheobronchial node, (5) the right posterior hilar node, (6) the paraesophageal node (Vesalius), (7) the nodes along the cardia, and (8) the nodes of the left gastric group.

poor supply of blood, and (2) a rich lymphatic bed. The latter circumstance permits a varied and complicated metastatic pattern because metastases do not necessarily occur in segmental fashion but may occur first at some rather distant point. The demonstration in patients of the presence of metastatic involvement can be undertaken by three means: clinical examination, radiologic examination, and direct examination at surgery.

The physical examination is of practical value only for metastatic involvement occurring in groups of nodes accessible to palpation, such as the supraclavicular, carotid, or axillary, and presupposes of course gross enlargement of the nodes. As a general rule, a cancer of the esophagus (except in the cervical and cervicothoracic portions) which is accompanied by palpable metastatic lymphadenopathy is exceptional and usually signifies a very advanced stage of the disease. Among some 500 cases of carcinoma of the esophagus, there were only 8 which presented palpable lymphadenopathy.

The search for metastatic lymphadenopathy located intrathoracically was done by means of roentgenography, but it can be said that for practical pur-

poses metastatic lymph adenopathy in this region is not recognizable radiologically even though the nodes may have attained some size. They become demonstrable only if their density is increased by some such process as calcification. Using several illustrative roentgenograms, the author demonstrates this point, and calls attention to the fact that by positioning the patient, one may superimpose pulmonary or other intrathoracic shadows on the mediastinum and lead to the erroneous impression that metastatic involvement is present. This is obviated by the proper interpretation of films in more than one position.

Experience with many cases of carcinoma of the esophagus subjected to surgical exploration permits certain conclusions concerning the demonstration and importance of metastatic involvement.

The relationship of metastatic involvement to the size of the primary tumor is not a direct one often being, in inverse ratio. It is the author's belief that the extensiveness of metastatic involvement bears a direct relationship to the duration of symptoms rather than to the size of the original lesion.

In lesions occurring below the level of the tracheal coryna, the presence of involved paroesophageal nodes (nodes of Vesalini) is constant.

The importance of considering the removal of the metastatic field is emphasized by pointing out that this may be a determining factor in selecting a right or left surgical approach, because tumors located below the tracheal bifurcation involve predominantly the subcorynal and paroesophageal nodes and the nodes along the left gastric artery whereas tumors above this level involve nodes at the tracheal coryna, the paratracheal fossa and all along the right subclavian artery where the recurrent laryngeal nerve circles it. Thus, the lower tumors seem manageable from the left side, whereas the higher tumors may indicate an approach from the right side.

The presence or absence of metastatic nodes may finally determine whether a resection is justified, although it seems that the author is willing to perform palliative resection, leaving metastatic nodes, if the re-establishment of gastrointestinal continuity is possible.

HIRSH T. LAMOSTON, M.D.

SURGERY OF THE ABDOMEN

ABDOMINAL WALL AND PERITONEUM

Massive Congenital Umbilical Hernia Amniotic Hernia (Las grandes hernias Umbilicales congénitas—hernias amnióticas) JOSÉ M. JORGE. *Bol Acad argent cir.*, 1947 31 705

When a massive umbilical or epigastric hernia occurs in the newborn the possibility of eventration transcends the importance of the hernia. Immediate operation is indicated before malnutrition, erosion, infection or other complications can intervene. The principal consideration should concern the volume of the eviscerated structures and whether or not the abdominal cavity is sufficient to contain the displaced viscera. The case history of a 3 month old child with a gigantic congenital embryonic umbilicoepigastric hernia containing the intestines, stomach and liver is described (Fig. 1).

Röntgenograms revealed the dangers of replacement of the organs in the abdominal cavity. Pneumoperitoneal injection facilitated abdominal distention, replacement, and retention of viscera in their normal relationship. The overlying skin was not sacrificed but permitted to remain intact for possible future demand commensurate with the growth of the child.

The infant mortality in these large hernias was considered extremely high, the cause being shock or embarrassment of the abdominal viscera when confined to an abdominal area too small to hold them properly.

STEPHEN A. ZIEGLER, M.D.

The Importance of the Conformation of the Pelvis in the Genesis of Inguinal Hernia (L'importanza della conformazione del bacino nella genesi dell'ernia inguinale) CARLO PIANA. *Arch ital chir* 1947 69 309.

Pelvic measurements were taken of 500 patients with inguinal hernia at the Bassini Institute, Milan. Of these patients, 453 were male and 46 female. A review of the literature pertaining to the relationship between inguinal hernia and pelvic measurements is presented. The author does not agree with Harris and White who concluded that the type of inguinal hernia is related to the length of the inguinal ligament.

On the basis of these measurements the author makes the following conclusions:

1. There exists in individuals with inguinal hernia a dysmorphism of the pelvis which can be defined as bacino emiloso hernial pelvis.

2. With regard to the single components which make up this dysmorphism it is noted that:

a. The inguinal ligament is longer than normal.
b. The length of the ligament varies in minimal measurement with the type of hernia, direct or indirect. Therefore a differential clinical diagnosis can not be made of the different types of her-



Fig. 1 (Jorge)

nia on the basis of the length of the inguinal ligament.

c. The large pelvis presents an enlargement in all diameters in males with inguinal hernia.

d. In females however the enlargement is minimal in certain diameters, whereas in other diameters it is less than normal (sacropubic, bitrochanteric). In the male the hernial pelvis tends to be larger than normal, whereas in the female it tends to be smaller than normal. All measurements taken into consideration it can be said that the female hernial pelvis has a tendency to approach the form of that of the male.

e. The height of the pelvis measured from the inferior margin of the pubis to the midpoint of the bisiliac line is larger in individuals with inguinal hernia than in normal individuals.

3. The pelvic dysmorphism modifies the morphologic aspect of the inguinal canal and consequently its valvular action. Bassini attached great importance to this fact as he believed that it created a condition favorable to the development of inguinal hernia.

LUCIAN J. PROSDUTI, M.D.

Streptomycin in Surgical Infections. Peritonitis.

EDWIN J. PUTASKE, SAM F. SEELEY and CHARLES S. MATTHEWS. *Surgery* 1947 22 589

Sixty three patients with peritonitis of varying etiology of whom 5 died received adjuvant streptomycin therapy alone or in combination with penicillin. Sulfadiazine was added in a few cases. The beneficial effects of early streptomycin therapy in early spreading peritonitis closely paralleled those

observed in cases in which large doses of penicillin were given. Streptomycin did not seem to be of particular value in the treatment of localized peritoneal suppuration.

On the basis of these preliminary studies, it is apparent that streptomycin is not a panacea, but has a valuable place in the treatment of peritonitis. Used alone, it is especially effective in spreading and localizing types of infection without a palpable mass. Used in conjunction with penicillin, it is effective in many patients who fail to respond to penicillin alone or to penicillin combined with sulfonamides.

SAMUEL KAHN, M.D.

Tumors of the Mesentery (Tumori del mesentere) C. SIMONETTI. *Ann. Ital. chir.* 947 24 333

The article is concerned with roentgenologic signs which assist in making a diagnosis of mesenteric tumors.

The mobility of the tumors with respiration and upon manipulation is considered of great importance.

Another criterion is the ability to demonstrate air between the mass and the posterior wall by means of pneumoperitoneum. In this way the mass is surrounded by air on all sides except where it is attached to the posterior wall. Theoretically however a retroperitoneal mass which grows and forms a pedicle will give the same signs. Practically however it is difficult to isolate the mass completely from the posterior parietal peritoneum by gas.

The differential diagnosis is concerned with ovarian cysts, cysts of the large ligament, pancreas, liver and spleen, movable kidney inflammatory tumefaction, and neoplastic tumors of the retroperitoneal tissue.

Three case reports are given, in 2 of which the diagnosis was confirmed by operation. One tumor was a lymphosarcoma and the second represented a metastatic growth from prostatic cancer. The tumor not subjected to surgery was considered to be a lymphosarcoma which was treated with x rays. The mass became smaller but the patient's condition continued to get worse and death occurred a month later.

LOUIS J. F. OTTO, M.D.

GASTROINTESTINAL TRACT

Section of the Vagus Nerve to the Stomach in the Treatment of Peptic Ulcer. LESTER R. DRAGSTEDT, PAUL V. HARPER, JR., E. BRUCE TOYKE, and EDWARD R. WOODWARD. *Ann. Surg.* 1947 126 687

During the period from January 18, 1943 to March 1, 1947 division or resection of the vagus nerves to the stomach as a method of treatment was employed in the University of Chicago Clinics in 23 patients with various types of peptic ulcer. One patient died of aspiration bronchopneumonia, and there have been no deaths in the last 150 vagotomies performed. Adverse reflex effects that might be ascribed to stimulation of the vagus nerves have not been seen. The clinical results of the operation have been excellent and have given the authors the im-

pression that a benign peptic ulcer may be regularly expected to heal if all the vagus fibers to the stomach are divided.

This is best accomplished by exposure of these nerves along the lower esophagus by either a transabdominal or a transthoracic approach. The transabdominal operation has the significant advantage that it makes possible inspection and palpation of the lesion and the performance of a gastroenterostomy should cicatricial obstruction at the pylorus be present. Gastric vagotomy abolishes the nervous phase of gastric secretion and decreases very markedly the total amount of gastric juice produced. These effects appear to be permanent. Evidence of regeneration of the secretory fibers in the vagus nerves has not been observed even in the patients operated upon 4 years ago. These findings suggest that regeneration of the divided vagus fibers will not prove to be a troublesome feature of this type of operation.

Complications and undesirable sequelae that have been encountered are intercostal pain or neuralgia, pleural effusion, pulmonary atelectasis, delayed emptying of the stomach, and diarrhea. For the most part these complications have been mild and self limited. Careful attention to postoperative care reduces the incidence and severity of most of them. Persistence of ulcer symptoms has been observed in 5 patients, and in these physiologic tests have indicated that not all the vagus fibers were divided. In 2 of these patients a second operation was performed and a residual vagus fiber was discovered and divided.

These findings suggest that to be effective in abolishing the nervous phase of gastric secretion and causing the healing of benign peptic ulcers, removal of the vagus innervation of the stomach must be complete. It is probable that the poor results secured by the early workers in this field were due to the fact that attempts were made to section the vagus nerves in operations directed at the stomach instead of at the esophagus and therefore they were in all probability incomplete. The necessity of repeated physiologic tests to determine residual vagal innervation of the gastric glands is clear and should be emphasized.

JOSEPH GASTRICK, M.D.

A Contribution to the Study of Gastric Abscess (Contributo allo studio dell'asscesso gastrico) DOMENICO MARTINI. *Gior. Ital. chir.* 947 3 54

Suppurative processes in the stomach are rare and for the most part are represented by operative surprises or autopsy reports. Only in rare cases has the diagnosis been made before operation. The condition was first reported by Galen (1037). According to the most recent statistics there have been about 35 cases (Sgildiani 941).

The male is more often afflicted, from 71 to 83 per cent, and while both young and old may be affected this condition is most commonly seen between the ages of 30 and 50 years.

Many classifications have been presented, but all have been discarded for the more simple diffuse and

circumscribed suppurative gastritis. The most common organism is the pyogenic *Streptococcus* which is present in from 70 to 78 per cent of the cases. It may be present alone or in combination with other bacteria: the *Bacillus coli* and proteus, the *Diplococcus* and the *Staphylococcus*. Very infrequently the *Staphylococcus* or *Diplococcus* have been found in pure culture, and rarely the *Bacillus coli* and *Bacillus anthracis*.

The pathogenesis is said to be dependent upon the presence of three factors: (1) diminution of the gastric acidity, (2) a traumatic lesion and (3) virulent streptococci. As one gets away from these factors it becomes increasingly more difficult to produce inflammatory lesions in the gastric wall. The juxtapyloric area is the most frequent site. The macroscopic appearance is that of irregularity and a consistency sometimes fibrous other times moist. The serosa is hyperemic and edematous with lymphangitis and a deposition of fibrin on the affected zone.

The symptoms of gastric suppuration are so complex as to make the diagnosis difficult and at times impossible. Generally there is a picture of acute pain fever and accentuated leucocytosis. It may simulate a perforated peptic ulcer or empyema of the gall bladder.

The condition may be cured by emptying of the pus into the stomach spontaneously but more often there is a spread with consequent purulent peritonitis, localized or diffuse.

The treatment is surgical and depends upon the nature of the lesion. In the presence of a diffuse phlegmonous form the prognosis is poor and only drainage is recommended. If the lesion is localized, different methods have been used, varying from simple drainage, gastrostomy gastroenterostomy and gastric resection.

A case report in a 24 year old male is reported. He was operated upon for a perforated duodenal ulcer. When the abdomen was opened multiple adhesions were found and were liberated. The abscess was found in the gastric wall. A Polya type of gastric resection was performed and drainage with gauze and a rubber tube was instituted. A subtotal closure of the abdominal wall was used and the wound was closed by second intention. The patient was discharged as cured in 42 days.

LUCIAN J. FROMDUTT, M.D.

Benign Tumors of the Stomach. *National Statistics (Tumores benignos del estómago estadística nacional)* ALEXANDRO J. PAVLOVSKY and DANIEL J. JOLY. *Revista med. argent.* 1947 34 1168.

The authors give the incidence of gastroduodenal polyps in Argentina, comparing their findings with those of previous studies made abroad. They found 41 polyps at operation. Of these 35 were benign and located in the stomach; 1 was benign and located in the duodenum; 1 benign gastric polyp coexisted with a gastric cancer and 4 gastric polyps were regionally benign but had become malignant. Of the benign polyps of the stomach

13, or 37.1 per cent were correctly diagnosed before operation and 22 or 69.0 per cent, were mistaken for other conditions. The most frequent incorrect diagnosis was gastric cancer.

WILLIAM E. RICKETTS, M.D.

Carcinoid Tumors of the Stomach (I carcinoidi dello stomaco) ACHILLE ELIO GALLIMARO. *Arch. ital. chir.* 1947 69 239.

The author reports a case of carcinoid tumor of the stomach which represents the fourteenth reported case in the world's literature, the second in the Italian literature and the fifth to come to the operating table.

After having discussed the differential diagnosis from the histologic point of view keeping in mind the data reported in the previous cases, the author believes that aside from the eventual gastroscopic reports there is no other sign which can lead to the diagnosis. His preoperative diagnosis was duodenal ulcer.

As to treatment, he recommends ample gastric resection inasmuch as carcinoids, although usually benign, may undergo malignant degeneration at any time.

As for the histogenesis, the author believes that the theory of embryonal malformation is the only one which can justify the great rarity of these tumors in the gastric region, and explain the frequent absence of the affinity for chromaffin and silver stains on the part of the neoplastic cellular elements. Even in the absence of specific impregnations, the certain diagnosis of carcinoid is rendered possible by other characteristics of major constancy. Among these are the submucosal position of the tumor, its entire delimitation, the more or less abundant stroma rich in elastic fibers and smooth muscle, and the frequent variable aspect of the cells which are regularly benign.

LUCIAN J. FROMDUTT, M.D.

Cancer of the Stomach (from a Radiologist's Point of View) J. L. A. GROUT. *Brit. J. Radiol.* 1947 20 491.

Perhaps the most disturbing feature of carcinoma of the stomach is the short duration of the symptoms, even in cases in which the growth in the stomach is extensive and often inoperable. Hence the radiologist is faced with the fact that a large percentage of patients with suspected carcinoma of the stomach are referred to him when the disease is already far advanced. The radiologist is often left with the thankless task of confirming the presence of a new growth already diagnosed by the physician or surgeon.

The author presents a number of interesting case histories and radiographs to illustrate the extensive lesions which may be present in a person with symptoms of very short duration. The role of gastroscopy as an aid to the diagnosis of carcinoma of the stomach is emphasized. Mistakes made in radiology can many times be corrected by a good gastroscopic examination.

It is emphasized that radiography is not the means of making a final diagnosis, but it should play an important part in the evidence collected before a final opinion or judgment as to the nature of the disease is given. The clinician must realize that the radiologist is not a robot and his opinions are not necessarily final nor closed to contradiction. If the clinician would avoid the use of the words "the X ray shows" and use instead "the radiologist says," a better understanding of the two points of view would prevail and a more practicable and useful approach could be made to the problems of diagnosis and research.

HAROLD LAUFMAN, M.D.

Gastrosocopy in the Diagnosis of Gastric Cancer H. W. ROOZEK. *Brit J Radiol* 947 20 505

Gastrosocopy should logically follow the x ray examination in the routine investigation of dyspepsia, and in a case suspected of carcinoma. It is particularly important that this routine should be adhered to for there are certain important contraindications to gastrosocopy in the presence of carcinoma which are diagnosable from the roentgenogram. If the x-ray examination has already demonstrated an advanced carcinoma, gastrosocopy will not be of any further help in such a case there is risk of rupture of the growth or perforation with the instrument. Another contraindication to gastrosocopy even when a carcinoma is suspected is gross deformity in the course of the esophagus, due either to spinal curvature or to intrathoracic displacement. Atrophy of the mucosa of the esophagus occasionally accompanies carcinoma of the stomach, although this does not constitute an absolute contraindication to the use of the instrument however it does call for the greatest care in its passage.

Gastrosocopy is indicated in a case clinically suspected of being carcinoma when the roentgenogram has revealed either no lesion or a lesion of obscure nature. It is further indicated when an ulcer appears to be innocent on the screen, but carcinoma is suspected clinically.

There are 4 manifestations of carcinoma of the stomach as seen with the gastroscope

1. Projection of neoplastic material into the lumen. The cauliflower mass as a rule is seen easily the multicolored necrotic surface appearing very different from the surrounding gastric mucosa. The surface of such a neoplasm is usually covered with blood, mucus, and slough.

2. Ulceration of the growth. Ulcers vary greatly in size and shape, but the following characteristics are usually retained a raised irregular edge, irregular in color and contour a sloughing floor containing blood and necrotic tissue irregularity or nodularity of the surrounding mucosa and raising of the whole ulcer above the surrounding mucosa. Ulcerated carcinomas constitute the commonest type of gastric growth.

3. Fibrous ulcer with malignant change—the ulcer cancer. The gastrosocopic characteristics of such a lesion are irregular hyperemia of the ulcer

region or of the surrounding mucosa an irregularity in the outline of the ulcer especially a breaking up of a part of the smooth margin by an irregular nodularity the appearance in the floor of the ulcer of blood clot or necrotic tissue instead of the comparatively smooth greenish gray although seen in innocent ulcers infiltration of the surrounding mucosa with carcinoma. This type of lesion has gradations from an innocent looking ulcer to the ulcer which is obviously the starting point of a widespread carcinomatous infiltration. These cases are the ones which tax the diagnostic skill of the gastroscopist to the utmost.

4. Submucous infiltration as seen in leather bottle stomach. The affected walls are devoid of folds or the normal mammillation and are composed of completely irregular nodules which may be pale in places and hemorrhagic in others, with a considerable excess of dirty mucus on the surface. The affected mucosa is rigid and changes little if at all, on inflation while the unaffected parts distend normally. Superficial ulcers are common in this type.

An ulcer with a suspicion of malignancy at the angulus may justifiably be left for a decision at a re-examination in 14 days. A similar ulcer seen on the greater curvature should be operated on without delay.

Since the outcome of gastric carcinoma remains so gloomy, the author suggests a careful but enthusiastic effort in the search for precancerous lesions. He considers three varieties of lesions in this category (1) polype and adenomas (2) chronic gastric ulcer (3a) gastritis with atrophy and (3b) gastritis without atrophy.

Associated with carcinoma of the stomach one frequently finds that the mucosa contains an undue number of very fine blood vessels finer than the usual submucosal veins. These blood vessels, the author believes, lie in the mucosa itself and he has therefore called them intramucosal vessels. He finds these so frequently associated with carcinoma that he believes they might be considered precancerous lesions although these vessels are sometimes seen in patients not suffering from carcinoma.

HAROLD LAUFMAN, M.D.

Cancer of the Stomach: Some Pathologic Considerations. M. J. STEWART *Brit J Radiol*, 947 20 505.

From the pathologist's point of view the problem of diagnosing an ulcer cancer of the stomach remains an exceedingly difficult one. The chief histological difficulty is in determining whether there is sufficient evidence to say that a simple chronic ulcer has certainly preceded the onset of epithelial malignancy. The bone of contention among pathologists rests on the following question. Can peptic ulceration occurring in a primary carcinoma so destroy at least the central part of the growth with its replacement by simple chronic inflammatory tissue as to render it, in that part at least indistinguishable from a simple lesion? Alternatively can peptic ulceration, commencing in a primary cancer spread from the growth

onto the adjacent healthy (or at least non neoplastic) stomach wall and produce a like result?

There are cases in which the pathologist hesitates to give an opinion unless buttressed and fortified by clinical evidence. In nearly all the cases which the author includes in his series of ulcer cancers there is a gastric history of 2 years or longer. However there are exceptions to this statement since in many patients there was an interval of freedom from symptomatic ulcers or ulcers and gastric carcinoma.

The range of acidity in the ulcer cancer approximates that of simple chronic ulcer much more closely than that of primary carcinoma. Twelve of 58 patients with primary cancer secreted a juice of normal or brightened acidity without anatomic simulation of ulcer cancer.

From the prognostic point of view, the author's impression is that the outlook in scirrhus cancer is unfavorable as compared with encephaloid. Even in tumors of considerable size if these are of the polypoid or fungating encephaloid type and provided the surgeon has been able to achieve an apparent removal of the whole growth with a reasonable margin of apparently healthy tissue the prognosis is incomparably better than in scirrhus cancers how ever small and however recent they appear to be.

Admittedly scirrhus cancer is of slow evolution but the chances are that by the time the case comes to operation lymphatic permeation has already extended far beyond the confines both of the stomach itself and of the regional lymphatics ordinarily removed in the operation of gastrectomy. In patients with ulcerating cancers of encephaloid type are likely to prove much more rapidly fatal than those of the scirrhus type. No doubt, the better prognosis of the encephaloid cancer after operation is in part accounted for by its earlier diagnosis and consequent earlier treatment. Widespread suppuration is frequent in the softer and more massive types of gastric cancer and may lead to peritonitis after surgery.

HAROLD LAUTMAN, M.D.

The Surgical Aspect of Carcinoma of the Stomach

HARMON TAYLOR *Brit J Radiol* 1947 30 507

Although the primary diagnosis of carcinoma of the stomach rests upon radiology and gastroscopy, the question of operability can be finally decided only after the surgeon has opened the abdomen. When distant metastasis in the liver or peritoneum especially in the pelvis or local extension of the growth into the posterior abdominal wall or diaphragm indicates a fatal outcome, some surgeons will nevertheless carry out a palliative gastrectomy for the relief of symptoms. The author does not agree with this point of view. When widespread metastases are already established the primary growth is generally not responsible for the main symptoms or the fatal outcome and in the absence of obstruction there is little to be gained by removing it. Gastrectomy is the simplest and therefore the best

means of dealing with obstruction of the pylorus in the inoperable case.

Individual operative mortality statistics are misleading and can be interpreted only in relation to the proportion of operations in which the growth was removed and the proportion of patients who escape recurrence of the lesion in subsequent years. Much depends upon the skill and experience of the surgeon and upon his determination to take serious risks if thereby he can give the patient a chance of cure. If there are no distant metastases the author believes that every risk should be taken to resect the growth. The surgeon should be prepared to remove the whole stomach together with omentum, the spleen, the transverse colon and the tail or body of the pancreas if these are involved in the lesion. It may be supposed that even successful removal of a growth so extensive must surely be followed by recurrence but this is not necessarily true. Among 38 patients subjected to radical removal of gastric carcinoma in the author's series there were 17 in whom one or more of the viscera were removed with the stomach. Of these 7 died as a result of the operation of the 10 survivors 8 are still alive and well from 1 to 4 years afterward.

In the last decade many helpful advances have come to the aid of the surgeon. One need only mention penicillin, curare, the endotracheal tube and the refinements of blood transfusion. Although the risk is in each case far reduced by these means, the mortality rate for operations for carcinoma of the stomach remains high because the surgeon is encouraged to undertake still more extensive removal of tissue when necessary.

In recent years growths of the cardia have become ever more removable. The growth is exposed through the left side of the chest and the left dome of the diaphragm and the resection accomplished with which he never successfully earned out but which now has become practicable.

HAROLD LAUTMAN, M.D.

Late Effects of Total Gastrectomy in Man

M. MACDONALD, FRANK J. MOELLINGER, and HELEN W. BELZING *J. England J. Med.* 1947 337: 837

Studies on patients who have survived total gastrectomy for 3 years or more are few and contradictory results are reported.

Studies have been made of intestinal motor function, intestinal absorption, pancreatic function and the blood picture in 3 patients who have survived total gastrectomy for 3, 5 and 10 years respectively. The first patient who survived total gastrectomy was studied 50 years ago and it was noted with surprise that she regained her appetite. Since then others have observed that the stomach is not necessary for this sensation. All patients have a normal desire for food and develop hunger. None of the patients have dysphagia or symptoms suggesting the dumping syndrome. The weight has never regained the levels existing before illness.

Fluoroscopic and radiologic examination revealed a normal esophagus and a patent, well functioning esophagojejunal anastomosis.

Until recently, the patient of Zikoff was considered the longest survivor after total gastrectomy for carcinoma, since Finney and Reinhold reported her alive 4 years and 8 months after operation. Zikoff's article, however, is an early postoperative report which does not contain any information concerning subsequent survival. Attention is directed to a much overlooked reference to the Lichtenhan lecture of 1906 by H. J. Paterson. In this monograph he quotes a personal communication from MacDonald of San Francisco to the effect that the patients of Brooks Brigham and of MacDonald were alive and well 8 and 7 years after their operations. Incidentally the operations were the second and third successful total gastrectomies reported in the literature. One of the patients studied is alive and well 10½ years post-operatively whereas the patient described by Poole and Foster is still alive and well 20 years after the complete removal of the stomach for a nonmalignant condition. These 3 cases appear to represent the longest known survivals after total gastrectomy for malignant and nonmalignant tumors, respectively.

Studies on 2 patients who had survived total gastrectomy 10 and 3 years, respectively and on 1 who had survived total gastrectomy, splenectomy, and partial pancreatectomy 5 years revealed the clinical condition of the patients with total gastrectomy alone to be excellent. Considerable dilatation of the jejunum near the esophagojejunal anastomosis was demonstrated by roentgenologic and kymographic methods in 1 case. In both cases, the pancreatic enzymes were normal and fat absorption on a low fat intake was not significantly impaired. Vitamin A tolerance curves showed an apparently delayed but otherwise normal absorption of the vitamin. Glucose tolerance tests disclosed an early and marked but transient hyperglycemia.

The patient with total gastrectomy, splenectomy and partial pancreatectomy experienced difficulty in maintaining weight. Dilatation of the jejunum was present. The pancreatic enzymes were deficient, fat absorption was impaired and the vitamin A tolerance curve was flat. The glucose tolerance curve showed a hyperglycemia, which was sustained.

Blood studies demonstrated that 2 of the 3 patients developed a macrocytic, hyperchromic anemia 3 and 5 years, respectively after operation. The third had received prophylactic liver treatment. A review of the literature revealed a high incidence of macrocytic, hyperchromic anemia in patients surviving total gastrectomy for 3 or more years.

The evidence appears to support the statement that an anemia morphologically similar to Addisonian pernicious anemia will develop after total gastrectomy if the patient survives long enough. Whether the anemia is truly Addisonian or whether it is another form of macrocytic anemia requires further study. In the past most patients developing macrocytic anemia after total gastrectomy have

been incompletely studied, for the effects of dietary deficiency have not been excluded—liver and iron have been administered indiscriminately—and special studies like reticulocyte counts and bone marrow examinations have been few. Only if macrocytic anemia that follows total gastrectomy is carefully investigated by the methods used by Meyer *et al.* can its relation to Addisonian pernicious anemia be clarified.

HARRY W. FOX, M.D.

The Surgical Management of Gastrojejunal Colic Fistulas. ROBERT F. BARKER and JOHN L. MATTEN. *Surgery* 94:7:1657

A series of 6 cases of gastrojejunal colic fistula is reported. The authors consider the multistage method of treatment with the use of a preliminary colostomy as described by Pfeiffer the most logical from a surgical standpoint. A historical review of the surgical attacks on gastrojejunal colic fistula is given.

The method of Pfeiffer is preferred by the authors because (1) there is cessation of diarrhea with a return of the patient to excellent physical status and hence reduction of the general risks of surgical intervention (2) there is subsidence of the inflammatory reaction of adjacent tissues and the jejunal ulceration thus reducing the risk of inflammatory complications in the surgical correction of the fistula, (3) there is freedom from contamination at operation and later protection of suture lines in the repaired colon which abolishes the danger of leakage and (4) the operation is technically simple.

In the second stage of the procedure, which follows the colostomy from 6 to 10 weeks, the authors prefer a disconnection of the fistula followed by a subtotal gastric resection to the "simple restoration of gastro-intestinal continuity. Simple closure of the fistula combined with infradiaphragmatic partial vagotomy although not reported, is suggested for possible clinical trial.

W. FOSTER MONROE, M.D.

On Subcutaneous Injuries of the Intestine, with Special Reference to the So-Called Secondary Injuries. E. TIMMONS and J. ANTONIEN. *Ann. chir. exp. med.*, 1947 35:96.

In the period from 1935 to 1945 there were 32 cases of injuries to the intestine secondary to contusion of the abdomen in the three largest hospitals of Helsinki. The theory of mechanism for intestinal rupture without injury to the abdominal wall has been explained as one of three main types: (1) the intestine may be crushed (2) the intestine may be torn and (3) the intestine may be burst. Among the 32 cases there were 26 injuries to the small intestine, 5 to the large intestine, and 1 in both the small and large intestine. The prognosis is dependent upon the severity of the trauma, upon the state of shock caused by the trauma, and how soon after the trauma operation is performed. In the material reported there were 15 fatal cases. Three patients died of other associated injuries.

The only possible treatment is, of course, operative. It is more important to treat the shock after

trauma than to institute hasty operation. Adequate treatment of the shock requires a period of calm waiting which is far more essential than hasty operation immediately after trauma.

SAMUEL J. FODERSON, M.D.

Carcinoma of the Ampulla of Vater JOHN MORLEY
Brit. J. Surg., 1947 35 146

Morley described his experience with 6 cases of carcinoma of the ampulla of Vater. Treatment consisted of a radical two stage operation with ligation of the pancreatic duct. Four patients died. 1 was ill from ascending cholangitis some 7 months after operation and the sixth patient was well 11 months after the second stage of the operation.

The author discussed the merits of the one stage and the two stage operations. He does not approve of Whipple's method of restoration of the flow of bile, preferring a cholecystogastrostomy to the anastomosis of the divided common bile duct with the jejunum, nor of Whipple's policy of implanting the pancreatic ducts into the jejunum. Morley believes that ligation of the pancreatic duct is a safer procedure than anastomosis of this duct with the jejunum. This policy is based on the author's experience with 5 of his 6 patients who gained weight on an ordinary diet without the use of pancreatic extract. No serious failure of fat absorption was observed. Apparently the individual's nutrition does not suffer by withholding the powerful digestive juices—trypsin, lipase, and amylase—through the ligation of the pancreatic duct. Morley's sixth patient, however, developed an acute fatal pancreatitis which could be ascribed to the ligation of the pancreatic duct.

The article is concluded with the report of a questionable case of apparent spontaneous cure of ampullary carcinoma.

ROBERT TURELL, M.D.

Symptoms Due to Meckel's Diverticulum SELWYN
Taylor, Lancet Lond., 1947 2 786

The discovery of a Meckel's diverticulum during a laparotomy comes as a surprise to most surgeons for it is an uncommon congenital abnormality. Harkins (1933) who collected all the cases recorded when complete examination of the gastrointestinal tract was made postmortem found that in 25,149 autopsies this abnormality was present on 327 occasions—an incidence of 1.3 per cent. Among 69,000 admissions to the Truesdale Hospital Atwood (1946) has reported 37 patients with symptoms due to a Meckel's diverticulum. In the records of King's College Hospital there are numerous references to the finding of Meckel's diverticulum during abdominal operations, but only 11 times in the 18 years from 1928 to 1945 was this the actual cause of the symptoms which necessitated surgical intervention.

Thirteen cases are briefly reviewed with the addition of 1 case of different causation, as a result of which it is tentatively suggested that Meckel's diverticulum may be involved in the pathogenesis of chronic as well as acute abdominal pain.

Developmentally the vitelline duct connects the yolk sac and the midgut of the embryo at an early stage.

The intestinal portion of the duct persists most commonly and was the one first described by Meckel (1809, 1812).

The complications arising in connection with Meckel's diverticulum are briefly as follows: intestinal obstruction due to a band or to volvulus; perforation into the peritoneum; ulceration of heterotopic gastric mucosa (producing hemorrhage as indicated by melena and perforation); foreign body neoplasm; aberrant pancreatic tissue; and strangulation in the hernial sac (Littre's hernia).

An analysis of the last 11 cases of acute abdomen admitted to the hospital in which a Meckel's diverticulum was the causal factor shows examples of practically every known complication and confirms the opinion of previous writers on the subject that the correct diagnosis is rarely made before operation.

The most common situation for this development is 18 in. from the ileocecal valve but it has often been discovered from 12 to 36 inches from the end of the ileum; therefore unless the whole terminal 3 feet of ileum are inspected it may be overlooked.

Meckel's diverticulum should be looked for more often and more carefully especially in laparotomies in which the other abdominal organs do not appear sufficiently abnormal to explain the signs and symptoms.

HARRY W. FINK, M.D.

Carcinoma of the Large Intestine. ARTHUR W.
Allen, Surg. Clin. N. America 1947 57 1018.

Five case reports are presented to illustrate the usual procedures which were found satisfactory in the management of malignant lesions of the colon. With experience the method of choice has become resection with primary anastomosis. This growing tendency toward primary suture of the bowel has evolved through improvements in preparation of the patient, better surgical technique and chemotherapeutic aids. The author believes that the morbidity could be reduced by primary suture and the mortality rates could be kept as low as those reported by the advocates of the Mikulicz's principle.

An aseptic anastomosis is now not considered important because with better bowel preparation a satisfactory primary anastomosis can be obtained by the so-called open technique. Also complementary proximal decompression is used less frequently. Preliminary cecostomy is now done only in the presence of acute and complete obstruction of the left colon, and complementary cecostomy is rarely done. The Miller Abbott tube is used as an added precaution in some cases.

Preliminary transverse colostomy is used only in large obstructing inflammatory lesions of the sigmoid. This procedure is mandatory in diverticulitis with inflammatory extension and by this means one can count on the resolution of the acute process even in the presence of a frank abscess. Since carcinoma and diverticulitis may occur in the same region one

must consider an earlier resection in some cases. If bleeding and mucous discharge continue from the defunctioned segment, the diagnosis of cancer is established and the obstructive inflammatory features may be secondary to the malignant process. If cancer is obvious or strongly suspected the resection should be undertaken not later than the fourth week after transverse colostomy. If it seems reasonably certain that diverticulitis is the sole causative factor a better procedure can be accomplished after 3 to 6 months of decompression.

Following this discussion of the subject, case reports on (1) carcinoma of the cecum treated by end-to-end anastomosis, (2) carcinoma of the transverse colon treated by end-to-end anastomosis plus bilateral prophylactic superficial femoral vein interruption, (3) carcinoma of the descending colon treated by end-to-end anastomosis, (4) carcinoma of the rectosigmoid just below the pelvic floor also treated by end-to-end anastomosis, and (5) carcinoma of the sigmoid with endometriosis treated by (a) exploratory laparotomy and complete transverse colostomy and (b) resection of the sigmoid and panhysterectomy en bloc, followed by primary anastomosis of the descending colon to the rectosigmoid demonstrate the surgical procedures utilized.

SAMUEL J. FOCKELOT, M.D.

Adjuvants to Surgical Therapy in Large Bowel Malignancy. L. S. RAYBURN and HAROLD A. ZIMMER. *Ann. Surg.* 947: 36-43, 1953.

The authors suggest the following adjuvants to surgical therapy in malignancy of the large bowel:

1. Correction of anemia and hypoproteinemias by vigorous and repeated blood transfusion.

2. Large doses of vitamins given preoperatively.
3. Long tube decompression in all cases.
4. Chemotherapy (sulfonamides given orally) especially sulfasuxidine and sulfathiazidine. Streptomycin has been used lately.

Minor fecal contamination of the peritoneum at operation did not prove serious, and peritonitis has not been the cause of a single death in the year 1946 during which time 53 colon resections were done, 40 in one stage. Eighteen of the latter were performed by the open method. Prior to the adoption of the complete program as described, the total resectability for cancer of the colon was 64.5 per cent. During the year 1946 the total resectability was 78.6 per cent. The mean operative mortality from 1923 to 1938 was 18.4 per cent; since 1938 a definite portion of the program was used and the mean mortality was reduced to 3.6 per cent. In only 3 years prior to 1938 was the mortality ever as low as it has been in any year since 1938.

Resection with end-to-end anastomosis is supplanting the Mikulicz types of resection in the authors' clinic. On-stage procedures have entirely supplanted multistage operations except in the presence of perforation or obstruction.

Nothing replaces the gentle handling of the bowel, the greatest care in the conservation of the blood

supply, the prevention of major soiling, and the careful approximation of the bowel edges. However, in spite of this a number of patients will still lose their lives because of peritonitis from one cause or another. The adjuvants suggested have permitted a large number of one-stage in place of multistage operations, which reduces the risk of secondary anasthetization and they have led to more rapid recovery and a shorter period of disability and hospitalization in a larger number of patients. They have led to a substantial reduction in the mortality following operation on the colon and have played an important part in the very marked reduction in the incidence of fatal peritonitis following resection of the large bowel.

JOHN J. MALONEY, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Thrombosis of the Hepatic Veins: The Budd-Chiari Syndrome. R. B. THOMPSON. *Arch. Int. M.* 947: 80-803.

The author reports 3 cases of thrombosis of the hepatic veins and reviews 95 of more than 100 in the literature to emphasize that this syndrome is not always due to one disease process as is so commonly implied and to attempt to give a clearer conception of the various other processes which may cause it.

In the majority of the reported cases there was gross obstruction of the hepatic veins, which led to engorgement and necrosis of the liver and to portal obstruction.

It was proposed that the name Chiari or Budd-Chiari syndrome should be retained for cases in which there is gross blockage of the hepatic veins and that cases with more limited lesions not giving the full picture, should be referred to simply as cases of thrombosis of the hepatic veins. While this article is primarily concerned with the Chiari syndrome, remarks concerning the etiology and pathology of the latter type of cases are included also. Two previously accepted cases have been excluded.

The lesions found in the liver depend on the duration of the thrombosis. In the acute stage there is severe venous engorgement resulting in central lobular necrosis of the hepatic cells. Later cirrhotic changes develop and nodular regenerative hyperplasia is common.

The clinical features include abdominal pain which is usually the initial symptom. It precedes hepatic enlargement and ascites and is one of the most constant features.

The presence of venous collaterals is also one of the most important signs. Only a few reports mention a caput medusae.

The absence of gross jaundice and the presence of the slight, latent, or clinical form are the most important features.

The first correct diagnosis was made by Willcocks in 1866. Since then the syndrome has been diagnosed during life in 10 cases, including the 3 cases presented here. The great majority of cases present such

a typical picture that there are not many other disease pictures which resemble it.

The duration is variable. In the majority of cases the disease is of short duration in some lasting only a few days while in a smaller group the disease may last from 10 to 28 years.

The treatment of this disease unfortunately, does not offer much scope for discussion. It must be on the same lines as the treatment for portal cirrhosis. One point of great importance is that although this is an extremely fatal disease patients may live for many years before succumbing perhaps to a fresh thrombosis.

HARRY W. FINK, M.D.

Total Volvulus of the Gall Bladder (Volublo total de la vesícula biliar) GUSTAVO E. E. ANSCHUTZ *Bol Acad argen cir.*, 1947 31 806

In the world literature there were only 91 cases of total volvulus of the gall bladder reported up to the year of 1945.

The author reports this condition in a female 71 years of age. The symptoms were those of an abdominal crisis, namely, pain in the right hypochondrium, continuous vomiting, tenderness in the right hypochondrium and right iliac fossa, and no audible peristalsis.

X-ray examinations revealed a large tumor mass occupying the right flank and compressing the hepatic flexure of the colon. There also was a ptosis of the transverse colon.

On opening the abdomen the gall bladder was found to be the size of a large pear, free and erect. The cystic duct was twisted and it was impossible to visualize the cystic artery. The gall bladder was edematous and friable. It contained a great number of calculi and was filled with a black sanguino purulent, bile stained fluid.

The author stresses the value of x-ray examination in the diagnosis of this condition and believes that a large cystic duct with rudimentary mesocystic tissue in a thin patient with abdominal ptosis favors the development of volvulus.

ARTHUR I. CIFOLLA, M.D.

Considerations on the Pathogenesis of Calcified Gall Bladder (Considerazioni sulla patogenesi della colecisti di porcellana) PAOLO BIOCCA *Pediatrica sez chir.* 1947 54 173

The literature upon what is termed "calcified cholecystitis," porcelain cholecystitis, enameled cholecystitis, or "petrified cholecystitis" is reviewed. About 30 cases have been reported, 14 of which occurred in Italy. The condition is rare and Kirkland reports only 4 cases observed in 6,000 cholecystectomies at the Mayo Clinic. Of 10 cases reported by Pheasant, 4 were found at autopsy.

The clinical picture is usually that of mild gall bladder disease which usually occurred some time previously and had caused little or no disturbance since. The diagnosis is usually made by x-ray examination which reveals a radiopaque shadow in the upper right quadrant. The cortical area of the shadow

is usually most marked except for a small area near the neck which is considered to be diagnostic of gall bladder calcification rather than calcified echinococcus cyst of the liver or calcifications of the ribs, kidney, mesentery or peritoneum, from which it must be differentiated. The radiologic diagnosis is usually easy.

Two case reports are presented. One of a woman 70 years of age who was operated upon and found to have a walled-off perforated empyema of the gall bladder together with a calcified gall bladder. It was drained and she was discharged after a month with a partial biliary fistula. The patient died 11 months later of an acute pulmonary affection. The second case occurred in a 71 year old male. The gall bladder was palpated during routine examination for inguinal hernia and the condition was confirmed by roentgenography. Surgery was not advised.

The various causes for this condition as presented by different authors are discussed. According to the author of this article the pathogenesis of calcification of the gall bladder is as follows: a chronic stimulus, mechanical or infectious, produces a productive connective tissue reaction accompanied by mesoarteritis and endarteritis which is ultimately responsible for sclerosis of the involved vessels. A lipid infiltration associated with transitory hypercholesterolemia supervenes upon elements with diminished vitality (caused by a persistent local stimulus and deficient nutrition) and accentuates degenerative processes which lead to necrosis. Upon these necrotic areas the lipid infiltration produces a precipitation of calcium salts. LUCIAN J. FRONZOTTI, M.D.

The Method of Dissolution of Common Duct Stones Remaining after Operation B. O. C. PRIBRAM *Surgery* 1947 22 806

It is well known that stones in the common duct may be easily overlooked during an operation, however the frequency of this incident is not generally appreciated. It appears to be a fact that stones are left behind in from 16 to 25 per cent of all patients operated upon for choledocholithiasis even by the most experienced surgeons. Retroduodenal and transduodenal exposure of the papilla are operations which decrease the probability of missing common duct stones. Such operations have the relatively high mortality of 20 per cent and most surgeons are reluctant to use them in poor risk patients.

Two techniques have been developed to improve the result in operations for choledocholithiasis. Minzu's method of cholangiography during the operation and Pribram's method for postoperative dissolution of gallstones remaining in the common duct under cholangiographic control.

Cholangiography during the operation enables one to discover stones in the common duct which otherwise might be missed, but even with this method it is difficult to be certain that all stones have been removed. In a case in which multiple stones have been removed even though cholangiography has been carried out during the operation the surgeon should

never omit drainage of the common bile duct which provides opportunity for further cholangiographic studies in the post operative period.

The scaffolding of the usual gallstone is made up of cholesterol which is soluble in ether. By dissolving the scaffolding ether disrupts the structure of a stone, causing it to crumble into a mud the particles of which can easily pass through the papilla. The ether method therefore, is effective only against stones containing cholesterol.

It is of considerable practical importance to know that there is a good method of dealing with overlooked duct stones in the postoperative period under cholangiographic control. In the author's 51 cases in which the ether method was used for the post operative dissolution of gallstones remaining in the bile ducts there have been no failures nor has a secondary operation been needed. Failures reported by other surgeons must be due to a difference in technique. The first consideration is that of the solvent which is exclusively ether. The T tube for drainage of the common duct is not suitable with the ether technique because the ether evaporates upward into the liver instead of reaching the stone. For this and other reasons a catheter or simple tube stitched into the common duct is preferred. The surgical therapy for cholelithiasis consists of removal of the gall bladder opening of the common duct, removal of all stones possible insertion of a double barreled catheter downward into the common duct until the tip touches the stones in the ampulla, and closure of the wall of the common duct around the catheter with 5 silk sutures. On the fifth postoperative day the first cholangiogram is made with from 5 to 10 cc of warm lipiodol. When there is evidence of stone the ether treatment is initiated with ether injected drop by drop. The whole procedure may be repeated several times a day and continued for at least a week, after which another cholangiogram is made. With the gradual crumbling of the stone the tube can be passed easily through the open papilla into the duodenum. The time required for the dissolution of stones varies greatly and depends upon many factors. In many instances the patient has been dismissed from the hospital after 14 days with the choledochostomy tube in place and then treated as an outpatient. The time required for the dissolution of calculi varies from 1 to 6 weeks. The great advantage of this method rests in its safety and harmlessness.

SAMUEL J. FOGELSON M.D.

The Anatomy of the Pancreatic Ducts. The Etiology of Acute Pancreatitis. JOHN HOWARD and RALPH JONES. *Am J Med Sc* 947 4-67

The anatomy of the pancreatic duct system and of its relationship to the lower end of the common bile duct has been a subject of much interest since 1901 when Opie first presented his "common channel" theory of the etiology of acute hemorrhagic pancreatitis. This theory found its origin in Opie's now classic study of specimens removed at autopsy in a case of acute hemorrhagic pancreatitis in which a

small biliary calculus was found impacted in the papilla of Vater, converting the duct of Wirsung and the common bile duct into a common channel so that there had been a reflux of bile into the main pancreatic duct. The theory that the pancreatitis had been caused by the reflux of bile into the pancreatic tree was well founded because Claude Bernard had previously shown that the injection of a mixture of bile and olive oil into the pancreatic duct produced the disease in experimental animals. Opie's theory has subsequently been the subject of much study and considerable criticism, but many authors now agree with the opinion of Dragstedt that the common channel theory probably explains 60 to 70 per cent of cases of the disease in man.

It was originally thought that a calculus impacted at the ampulla of Vater was responsible for the formation of a common channel in all cases of pancreatitis, but subsequent studies of specimens at autopsy have shown that a calculus is the obstructing agent in not more than 10 per cent of clinical cases of this disease. On the basis of Archibald's work in animals, it is now believed that segmental spasm of the sphincter of Oddi is the obstructing agent which creates the common channel in the majority of clinical cases of the disease.

There are a number of prerequisites that must be fulfilled before Opie's common channel theory can be accepted. The first of these, as Opie realized is that the anatomic possibility of the formation of a common channel in a reasonable percentage of people must be established. It is obvious that the 2 ducts must unite to form a common ampulla before emptying into the duodenum and that the union must occur at a sufficient distance from the duodenal orifice to allow for obstruction of the orifice without obstruction of either of the ducts.

That a common channel exists in a limited number of persons has been proved in vivo by cholangiography. This study does not necessarily demonstrate all cases in which reflux is possible but it does offer evidence in vivo that reflux is anatomically possible.

The present study consisted of examination of 150 fresh unfixed specimens consisting of pancreas, duodenum, and common bile duct removed intact at autopsy at the Philadelphia General Hospital.

In 81 of 150 cases (54%) a common channel was created by the methods described and reflux of the injection fluid into the duct of Wirsung occurred. In 69 (46%) no reflux was demonstrated.

A patent duct of Santorini connecting the duct of Wirsung with the duodenum was demonstrated in 35 per cent of 150 cases.

In 44 per cent of the 81 cases in which reflux at the ampulla of Vater occurred, a patent duct of Santorini connecting the duct of Wirsung with the duodenum was demonstrated.

The authors conclude that this evidence confirms the finding of Cameron and Noble that the anatomic possibility for the formation of a common channel at the ampulla of Vater exists in at least 50 per cent of persons.

BENJAMIN GOLDMAN M.D.

Carcinoma of the Islets of Langerhans. Review of the Literature. BENJAMIN S. GORDON and RENE G. OLIVETTI *Gastroenterology* 1947 9 409.

In the Introduction of this paper the authors point out that prior to the discovery of insulin in 1922 very little interest existed in the subject of pancreatic islet cell tumors. However since the great discovery of Banting and Best, interest in these neoplasms has been progressively intensified.

Yet the number of islet cell tumors which are indubitably malignant are very few. The authors regard direct invasion of other organs or metastases as their criterion of malignancy. Classification of malignancy on the basis of histologic appearance alone is not acceptable evidence by the authors' standards. They have culled 20 cases from the literature and these are briefly reviewed. In addition they present in detail 2 of their own cases.

The authors conclude that carcinoma of the islets of Langerhans is a rapidly growing tumor which occurs more commonly in males, is more frequent in middle life, may or may not produce hypoglycemia, arises most often in the tail of the pancreas and metastasizes quickly and widely to neighboring and distant structures but most often to the liver and to nearby lymph nodes.

The duration of illness from the first definite symptoms to the time of death is variable. Of the 19 patients in whom the duration of illness was reported the largest number (8) had their first symptoms 6 months prior to death.

A discussion concerning the pathogenesis of islet cell tumors is presented and the authors conclude that the islet cells develop by a process of differentiation from the epithelium lining the smaller pancreatic ducts. Tumors may arise from mature well differentiated islet cells or from undifferentiated ductal epithelium.

EDWARD F. LEWISON, M.D.

MISCELLANEOUS

Neurogenic Abdominal Sarcoma (Sarcoma neurogenico abdominali). J. A. PÉREZ ALBARRÁN, F. PÉREZ MONTES, J. A. ACOSTA MONTEJO and M. S. BALAMBRIN *Rev. med. cir. Habana* 1947 53 320.

The authors present a case of acute abdominal crisis from a hemorrhagic neurosarcoma of the mesosigmoid. The patient was a 61 year old woman who was suffering from acute abdominal pain and fever. Examination revealed a hypogastric tumor on the left side with exquisite abdominal tenderness over the area. Shock appeared imminent and a tentative diagnosis of torsion or rupture of an ovarian cyst was made. Emergency operation revealed a large gray tumor with the appearance and consistency of the cerebrum. The mass was loosely attached to the anterior parietal peritoneum and to the fundus of the uterus, and was firmly embedded in the posterior parietal peritoneum and mesosigmoid from which it obtained its blood supply. Recent hemorrhage was evident and the pouch of Douglas was found to be filled with clotted blood.

The tumor was removed in its entirety. Complete recovery followed a stormy postoperative course and there was no evidence of the disease on roentgen examination 15 months later.

The tumor was the size of a grapefruit, irregularly ovoid, and its cellular components showed frank sarcomatous characteristics associated with glial nerve elements. A review of the literature revealed only 8 other indisputable similar cases. Histogenic studies showed the origin of the tumor to be from the sheath of Schwann.

The article gives a good summary of the history, histogenesis, etiology, frequency, location, pathologic anatomy, clinical study, symptoms, course, prognosis, and treatment of this disease.

STEPHEN A. ZIEGLER, M.D.

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The scaffolding of the usual gallstone is made up of cholesterol which is soluble in ether. By dissolving the scaffolding ether disrupts the structure of a stone causing it to crumble into a mud the particles of which can easily pass through the papilla. The ether method therefore is effective only against stones containing cholesterol.

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small biliary calculus was found impacted in the papilla of Vater, converting the duct of Wirsung and the common bile duct into a common channel, so that there had been a reflux of bile into the main pancreatic duct. The theory that the pancreatitis had been caused by the reflux of bile into the pancreatic tree was well founded because Claude Bernard had previously shown that the injection of a mixture of bile and olive oil into the pancreatic duct produced the disease in experimental animals. Opie's theory has subsequently been the subject of much study and considerable criticism, but many authors now agree with the opinion of Dragstedt that the common channel theory probably explains 60 to 70 per cent of cases of the disease in man.

It was originally thought that a calculus impacted at the ampulla of Vater was responsible for the formation of a common channel in all cases of pancreatitis, but subsequent studies of specimens at autopsy have shown that a calculus is the obstructing agent in not more than 10 per cent of clinical cases of this disease. On the basis of Archibald's work in animals it is now believed that segmental spasm of the sphincter of Oddi is the obstructing agent which creates the common channel in the majority of clinical cases of the disease.

There are 5 important prerequisites that must be fulfilled before Opie's common channel theory can be accepted. The first of these, as Opie realized, is that the anatomic possibility of the formation of a common channel in a reasonable percentage of people must be established. It is obvious that the ducts must unite to form a common ampulla before emptying into the duodenum and that the union must occur at a sufficient distance from the duodenal orifice to allow for obstruction of the orifice without obstruction of either of the ducts.

That a common channel exists in a limited number of persons has been proved in vivo by cholangiography. This study does not necessarily demonstrate all cases in which reflux is possible but it does offer evidence in vivo that reflux is anatomically possible.

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A patent duct of Santorini connecting the duct of Wirsung with the duodenum was demonstrated in 36 per cent of 50 cases.

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The authors conclude that this evidence confirms the finding of Cameron and Noble that the anatomic possibility for the formation of a common channel at the ampulla of Vater exists in at least 50 per cent of persons.

BENJAMIN GOLDSMAN, M.D.

A first series of experiments allowed the authors to answer these criticisms. Massive doses of estradiol benzoate were administered to young guinea pigs, intact or castrated at weekly intervals for several months. From these experiments three important conclusions were derived:

1. The adenocystic endometrial hyperplasia is not only inconstant but purely coincidental. The formation of cysts in the hyperplastic myometrium results from obliteration of the glandular ducts by a fibrous process.

2. The experimental lesions of the myometrium were polymorphic. Between these lesions and those of the spontaneous fibromyoma there is a definite difference, but the similarities between the two by far exceeded the dissimilarities.

3. The vascular factors play a fundamental role in the genesis and growth of a large number of experimental tumors. The proliferation of the vascular endothelium is the origin of numerous genital and extragenital tumors which are at first small angiomatous formations. An extensive fibrosis transforms the angiomatous nodules into an homogenous fibrous mass. This fibrous necrosis chokes the hyperplastic reactions of the connective tissues and epithelium.

Believing that a relation might exist between the degree of the fibrous process and the size of the doses of injected hormones a second series of experiments was carried out by the authors, using much smaller doses of estradiol benzoate. The results were in conformity with the authors' expectations: namely if the fibrous reaction is still present the hyperplastic phenomena are more evident and varied.

The nature of the cells which participate in the hyperplasia of the uterine muscles during gestation and various pathological experimental conditions has always been a matter of controversy. The authors quoted Keesler who stated that the multiplication of smooth muscle fibers results from a muscular differentiation (metaplasia) of the connective elements the fibroblasts. These fibroblasts would exist in the nonpregnant uterine muscle but they would be hidden between the smooth muscle fibers.

The authors claim that in the guinea pig there are no cellular elements similar to the fibroblasts described by Keesler. In the hyperfolliculinized female animal, the increase in number of the smooth muscle fibers is not the result of differentiation of pre-existing elements: it is conditioned by the proliferation of the vascular endothelium and the connective tissue cells surrounding them. These later on differentiate into smooth muscle fibers which by peripheral apposition form a regular thickening of the muscular fasciculi.

By studying the microscopic slides of the myometrium the authors have noticed mitoses to be most numerous in the external layers of the circular tunica. At this level there are large congested venous capillaries. Undoubtedly there is a relationship between the passive congestion and the degree of hyperplasia. It is probable that the passive congestion of certain vascular areas is in close relationship with

special vascular elements present in the uterine wall the action of which is perhaps initiated through sympathetic or parasympathetic nervous elements in response to hormonal excitation.

In the authors' opinion the excess of folliculin is the causative factor in the development of fibromyoma of the uterus. Furthermore the vascular reaction plays a fundamental role in the mechanics of its development.

GERARD GAGNON, M.D.

Data on the Treatment of the Fibromyomas of the Uterus Observed in 1945 and 1946, at the Obstetric and Gynecologic Clinic of Strasbourg (Remarques sur le traitement des cas de fibromyomes de l'utérus observés dans 1945 et 1946 à la Clinique d'Obstétrique et de Gynécologie de Strasbourg) R. KELLER and PH. PAQUET. *Rev fr gyn obst* 1947 42: 193

Two hundred and fifty-one patients with fibromyoma of the uterus were seen by the authors from May 1945 to July, 1946. A review of this series showed that 61 patients were in the fourth decade, 146 in the fifth decade, 42 in the sixth and 2 in the seventh. In 22 patients the fibromyoma was silent and was an incidental finding. In 16 instances the fibromyoma was a complicating factor of pregnancy, all but 2 of the 16 patients carried their pregnancy to full term. All of the patients experienced one or more of the following symptoms: (1) pain, (2) vaginal bleeding, (3) pressure, (4) dysuria, (5) weight loss, (6) increase in size of the abdomen, and (7) dyspareunia.

Conservative or medical treatment was used in 100 patients (40%) with 6 failures. This consisted of the administration of from 150 to 400 mgm. of acetosterandryl a month. It was given to young women with small painless fibromyomas and to old women whose general condition was poor. The size of the tumor alone was not an indication for operation.

One hundred and forty-seven patients (57%) were operated upon. The authors recommend operation when dealing with painful myomas, even if small myomas producing pressure symptoms; fast growing tumors; myomas associated with severe hemorrhage; intraligamentary and cervical myomas; myomas refractory to roentgen therapy, and obscure cases in which a definite diagnosis cannot be made clinically.

The operation of choice in the authors' opinion is myomectomy since the possibility of future pregnancy is preserved. Myomectomy is advocated (1) for women less than 35 years of age, (2) for sterile women, (3) when fibromyoma is associated with pregnancy, (4) when the growth however large is on the fundus, and (5) when fibromyomas are associated with prolapse. Myomectomy is carried out during pregnancy if the tumor is fast growing or painful, or if the fibromyoma is associated with retroversion of the uterus. Myomectomy is seldom performed during labor because of the high incidence of infection. During the postpartum period hysterectomy is preferred if infection already exists.

GYNECOLOGY

UTERUS

A Personal Method for the Surgical Cure of Uterine Retroflexion (Procedo personal per la cura chirurgica della retroflessione uterina) GIULIO RICCIMA. *Ann. Ital. chir.* 947 34 392.

A new method for the operative correction of retroflexion of the uterus is described by the author. One can foretell, by the results obtained from the one case reported that this type of repair does not expose the uterus to the grave danger of rupture during the contractions of labor. Even though there are uterine modifications the technique is simple.

A suprapubic transverse incision is made through the skin and subcutaneous tissue. After the fascia is incised by means of a vertical incision the rectus muscles are retracted laterally and the peritoneum is opened. The uterus is exteriorized and the retroflexion is reduced manually. Next a semicircular incision is made on the superior-anterior surface of the fundus down to the first and second layers of the myometrium. The curved portion of the incision is superior while the open ends are inferior. The superior lip is imbricated over the inferior lip and fixed in place with sutures, to correct the retroflexion. The length and height of the limb should be in proportion to the volume of the organ and to the degree of flexion. ARTHUR F. CIPOLLA, M.D.

Radical and Conservative Treatment of Uterine Ruptures (Sobre tratamiento radical y conservador de las roturas uterinas) CARMEN LOZANOSARAO. *ANAYA. Arch. Soc. cir. hosp. Santiago*, 947 7 470.

Within a period of 6 years and 5 months beginning with 1931 23 patients with uterine rupture during labor were operated upon at the Ramón Barros Luco Hospital. 13 were submitted to hysterectomy and 9 to simple laparotomy with repair of the lesions.

The first group included 5 complete ruptures and 8 subserous ruptures. The rupture involved the lower segment in 6 cases, the lower segment and the body in 6 and the body only in 1 case. It was due to an obstetrical maneuver (usually internal version) in 8 cases, to faulty assistance in the home in 3 and to spontaneous evolution at the hospital in 2 cases. Factors favoring the rupture were the presence of a cesarean section scar in 2 cases, low placental insertion in 3 and myomatous degeneration of the uterus in 1 case. The operation was performed immediately after the accident in 8 cases and a number of hours after the accident in the remaining 5 cases. There were 5 deaths, a mortality rate of 38.4 per cent. The cause of death was acute anemia and shock in 3 patients, peritonitis in 1 patient, and pyemia with multiple suppurative foci deep to sulfonamide and penicillin therapy in 1.

The second group included 3 complete ruptures and 7 subserous ruptures. The lesion was confined

to the lower segment in 8 cases and extended to the uterine body in 1 case. It was due to previous obstetrical maneuvers in 5 patients, to faulty assistance in the home in 3 and to spontaneous evolution at the hospital in 1 patient. The rupture occurred in a cesarean section scar in 2 cases. Repair consisted of simple suture of the lesion or suture associated with isolation of the involved area of the peritoneal cavity. drainage also was used, and all patients were given sulfonamides or penicillin locally and intravenously. There were 3 deaths, a mortality of 33.3 per cent. The cause of death was acute anemia in 2 patients and septicopyemia in 1 patient. Of the 3 patients in whom simple suture was used with drainage of the peritoneal cavity in 1 patient and local sulfonamide in 2 patients, 2 died. Of the remaining 6 patients in whom suture was combined with isolation of the involved area, only 1 died as a result of the development of infectious dehiscence of the uterine suture.

The author feels justified in concluding that, apart from the clinical conditions which must guide the conduct of the surgeon the surgical technique and the anti-infectious measures actually used in cesarean section are of great importance in the conservative treatment of uterine ruptures.

The mortality rates for the two groups of cases should not lead to the belief that the advantage lies in conservative treatment. The apparently more favorable results in these cases were due to the different clinical conditions under which treatment was instituted. The first group included 5 complete ruptures and 7 lesions which involved the uterine body while the second group included only 2 complete ruptures, and 1 spreading to the uterine body. The conservative treatment cannot be applied in all cases. The problem consists in judging whether the condition would respond to conservative treatment, while keeping in mind that radical operation offers the best guarantee for the survival of the patient.

RODMAN KEMEL, M.D.

New Experimental Contribution to the Study of the Pathogenesis of Fibromyoma of the Uterus. (Nou-elle contribution expérimentale à l'étude de la pathogénie du fibrome utérin) J. DUCONOT, P. GUILLERMIN, and C. BRUNES. *Gyn. Obst., Par.* 947 46. 432.

In a previous paper the authors discussed the various anatomoclinical and experimental factors favoring the theory of hyperfolliculism in the production of fibromyomas of the uterus. The two main criticisms held against such a theory are the inconspicuity of endometrial adenocarcinoma hyperplasia in the bearers of fibromyoma, which is considered the best test for determining the hyperfolliculism syndrome and the existence of essential differences between the spontaneous and the experimental fibromyoma.

for connective tissue but developed in a fine argentine network with which they are intimately connected for the time being these cells are called epithelioid cells to facilitate description.

Because of their characteristics the fibroblastic elements can easily be classified from the histogenetic point of view as thecal cells which are only slightly differentiated and show no tendency toward luteinization but classification of the epithelioid cells which constitute the major part of the tumor is more difficult. Their morphologic characteristics do not agree with those accepted for the cells of the theca and the granulosa, whether these cells are only slightly or greatly differentiated. The absence or at least the scarcity of intercellular fibrillary network militates against their thecal origin, as does also the poor amount of lipid without birefringence observed in them. The absence or scarcity of intercellular fibrils and of fatty substances together with the presence of peculiar arrangements in rosette form of some of the elements would suggest that these cells have originated from the granulosa but have no tendency to luteinization and even maturation. They would consequently be immature elements of the granulosa. In addition there would be some cells of thecal origin which would be a normal finding.

In the present case there were not only a few thecal elements but numerous tracts of them with prevalently peripheral arrangement as opposed to the more central arrangement of the cells of granulosa origin. This tumor would thus be a mixed one composed of immature cells of the theca and granulosa.

On the basis of these observations and considerations, the diagnosis of granulosa cell tumor was made. No macroscopic or microscopic suggestion of malignancy was found and the clinical condition of the patient at the time of the author's study allows the hope that cure will be permanent.

RICHARD KEMEL, M D

EXTERNAL GENITALIA

A Roentgenological Study and the Surgical Treatment of Congenital Transverse Occlusion of the Vagina (Etude radiologique et traitement chirurgical des cloisons transversales du vagin d'origine congénitale) A. GRANJON. *Gyn obst Par.*, 1947 46 303.

Complete occlusion of the vagina without any opening is extremely rare. Different methods have been used for repair of this malformation. The old method of excising the occluding membrane from below has been abandoned by many men because of the danger of secondary infection. Cases of fatal peritonitis after operation have been reported in the older literature. On the other hand the extravaginal way of repair by laparotomy is unnecessary in most cases and is a bigger intervention than is justified by the condition. Furthermore, the modern methods of local and systemic chemotherapy assure effective protection against infection from the vagina.

Before deciding on the method of procedure, the author performs a celloscopy in every case. If the tubes are distended laparotomy is indicated to treat the hematosalpinx by incision or resection. If the tubes appear normal, the diaphragm is opened by simple incision and the hematosalpinx is evacuated. The condition of the uterus and adnexa is investigated and if the cervix is open the uterus is evacuated. The plastic repair of the occluding membrane is postponed to a second operation.

In the more common cases of incomplete occlusion a catheter is introduced through the opening in the membrane and lipiodol is injected through the orifice in the membrane for colpohysterosalpingography. In these cases celloscopy is unnecessary as the permeability of the tubes can be verified by the salpingography. As to the surgical technique, the author is opposed to simple excision of the membrane

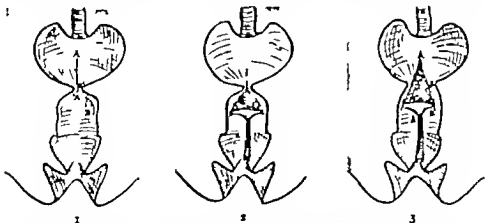


Fig. 1 (Granjon). Frontal section of the vagina. Schematic drawing of the incisions of the 2 aspects of the diaphragm. Inferior aspect: V-shaped incision. Superior aspect: anteroposterior incision.

Fig. 2. Inferior aspect of the diaphragm after incision in shape of V. The point of the V is at the orifice of the diaphragm. The flap of the dissected inferior mucosa is temporarily reflected downward.

Fig. 3. Superior aspect of the diaphragm. After anteroposterior incision the two edges of the superior mucosa are separated.

Myomectomy is contraindicated for: (1) patients over 45 years of age (2) tremendously large tumors (3) the presence of inflammatory lesions of the adnexa (4) the presence of carcinoma of the fundus or cervix, (5) fibromyomas associated with hemorrhage and (6) fibroma of the cervix. Cervical erosions are not a contraindication to myomectomy.

Supracervical hysterectomy was carried out 94 times with preservation of one or both adnexa and 18 times with removal of the adnexa. Cancer arising from the cervical stump is uncommon according to the authors who reported 3 cases among 21. Total abdominal hysterectomy was performed 5 times. Vaginal hysterectomy was done only when the growth was small and the uterus freely movable. Six patients were treated with radium and 4 were treated with roentgen rays. The authors believe roentgen therapy is indicated when dealing with large tumors after failure of medical treatment when the general condition of the patient does not warrant surgery. The authors reported 2 operative deaths (2.4%). The reported morbidity was very low.

GERARD GAGNON, M.D.

Limits of the Differential Histopathologic Diagnosis between Adenocarcinoma of the Cervix and Adenocarcinoma of the Uterine Body (Limiti della diagnosi istopatologica differenziale fra adenocarcinoma della cervice adenocarcinoma del corpo dell' utero) EUGENIO LUCCHI. *Riv. Ital. g.* 946, 29, 494.

A comparative study of the histopathology of 14 adenocarcinomas of the cervical canal and 55 adenocarcinomas of the uterine body revealed no characteristic elements which could be considered conclusive for the differential diagnosis of the two tumors, but if the elements prevailing in each of the two forms are taken into account and evaluated together instead of separately it will occasionally be possible to arrive at a highly probable diagnosis by observing the following characteristics:

1. Although the secretion of mucus does not belong exclusively to cervical carcinoma, it is more frequent and abundant in this tumor if a secretion is found also in adenocarcinoma of the uterine body it is not always one of mucus and it is therefore an excellent rule to apply the specific staining method for mucus so as to confirm or exclude the presence of the substance.

2. In cervical carcinoma there is a certain uniformity and an equality in the degree of maturity.

If a given portion of the tumor even if examined in various zones while in adenocarcinoma of the uterine body there is a certain polymorphism and a diversity in the degree of maturity of the epitheliomatous proliferation.

3. In cervical carcinoma an inverting type of development seems to prevail, while in adenocarcinoma of the uterine body the preceding development is especially associated with the everted type and more particularly if the tumor has a tendency toward a papilliferous picture.

4. In cervical carcinoma it is easier to find a small cell infiltration and a histoid reaction.

5. Necrotic phenomena which are not rare in tumors of the uterine body would seem to be more frequent in cervical carcinoma, together with some degree of hyaline degeneration of the stroma.

The histopathologic diagnosis is conclusive only when the examined material presents tracts of healthy tissue in one of the localizations in such continuity with the epitheliomatous proliferation as to leave no doubt about the origin of the neoplasm from the specific epithelial matrix of the site. In other cases the histologic findings play only a complementary and confirmatory role, and the differential topographic diagnosis between tumor of the uterine body and that of the cervical canal must depend especially on the evaluation of the clinical data provided by the gynecologic examination the symptomatology and the information obtained from curettage first of the cervical canal and then of the uterine cavity performed separately in two stages.

RICHARD KIMMEL, M.D.

ADNEAL AND PERIUTERINE CONDITIONS

Anatomoclinical Contribution to the Knowledge of Granulosa Cell Tumors (Contributo anatomo-clinico alla conoscenza dei tumori della granulosa) MASSIMO MACCIOTTA. *Riv. Ital. g.*, 1946, 29, 471.

Histologically granulosa cell tumors present a marked structural polymorphism as some have a distinctly epithelial aspect and others a frankly connective tissue aspect, while still others show a combination of the two giving rise to various pictures which are difficult to interpret and can only be individualized by repeated histologic and histochemical examinations associated with a study of the estrogenic substances. This polymorphism would be better explained by the concept that the elements of the granulosa are not of epithelial but of mesenchymal origin. The structural variability would thus appear more understandable especially if it is kept in mind that the cells of the granulosa may give rise to neoplastic forms at any time of their development and in various phases of their differentiation.

Macciotta has made a histologic study of a solid tumor of the left ovary removed from a woman 46 years of age who 3 years previously had had amenorrhea for 13 months followed by menstruations of menorrhagic type which appeared every 15 to 20 days and later assumed a serious menorrhagic character. Although numerous preparations from various parts of the tumor were examined it was impossible to demonstrate the presence of any follicles of de Graaf or of normal ovarian tissue, the entire tumoral mass seemed to consist of neoplastic elements only. These were of two types: (1) more or less abundant fusiform cells of connective tissue aspect with some indications of hyaline degeneration, and (2) massive groups of cells of various sizes, more or less well stained and nearly always with blurred contours, staining like epithelial elements with the methods

year. However, in only a few instances had the condition become worse than before the operation.

This gives a permanent cure rate of only 55.5 per cent, but this figure does not tell the true story since results have been improving from year to year as the operator has gained in experience and as he has allotted more study to the subject of the relaxation of the pubocervical ligament in particular and of the anatomy of the internal and external genitalia in general. Six women were operated upon in 1943 with 2 permanent cures, 8 in 1944 with 3 cures, 14 in 1945 with 7 cures, and 19 in 1946 with 13 ultimate cures. Results were better on the whole in younger women.

No rigid scheme of operative procedure was observed; the operative procedure to be followed was planned for each individual condition present. In the younger women with a simple stress incontinence, accompanied perhaps by cystocele, an anterior colporrhaphy was frequently all that was done. In the cases in which there was no evidence of downward displacement of the vesical neck other than mild displacement of the carinae urethralis when the patient contracted the abdominal muscles, plication of the urethral sphincter in the midline by Stoeckel's method or Kelly's mattress suture was resorted to. In these cases the author's modification of this operation was usually added. This consisted in a second line of sutures over the first but with plication of the relaxed tissues of the pubocervical fascia at right angles to the deeper suture line. The old Pavlik (Pawlik) method of urethral advancement as modified by Berkow Barger may be resorted to in the conditions which seem to require a lengthening and narrowing of the urethral lumen in addition to supportive procedures. As a rule the operation of uterine interposition was reserved for the patients in whom the incontinence had recurred after the previous operation.

The rather mediocre results of operation despite the evident improvement in later years, have caused the author to focus his attention on prophylaxis. In addition to care to forestall injury to the urethra, base of the bladder and pubocervical fascia during child birth, attempts are being made to train the bladder to empty itself during the puerperium and exercises (Cyriax method) have been instituted to strengthen the muscles of the perineum and abdominal wall.

JOHN W. BRENNAN, M.D.

Diverticula of Female Urethra (Divertículos de la uretra femenina). R. DE SURRA CANARD and J. IZARU. *Rev. argen. urol.*, 1946, 15, 481.

The authors concluded from their endoscopic studies that the juxtacervical segment, or the neck of the bladder in the female, corresponds to the prostatic urethra of man and the lower segment of the female urethra corresponds to the vestibular region of the male urethra.

Observations of 14 cases led the authors to the conclusion that there are two types of diverticulitis, acute and chronic. Purulent and catarrhal types of acute processes may be distinguished.



Fig. 1 (Canard and Izaru). The diverticulum separates the labia of the vulva.

Diverticula may produce a variety of symptoms according to their size, location and evolution. The condition may be easily confused with inflammatory lesions of other organs.

Palpation of a tumefaction in the anterior vaginal wall, congestion of the ducts of Skene's glands, results of endoscopic examination and urethrography help to establish the diagnosis.

Acute catarrhal diverticulitis requires the local application of drugs and massage. Small and medium size diverticula may be treated with the electrocautery while larger ones require extirpation.

JOSEPH K. NARAT, M.D.

Urethroceles. D. K. ROSE. *J. Urol. Balt.* 1947, 58, 549.

By the use of a graphic method the author wishes to offer ideas for analyzing and diagnosing the various types of urethrocele which may be seen in the daily practice of urology. An anatomically prepared female pelvis was presented which had been cut sagittally and accurately in the midline. It showed fibrous urethral attachments from the symphysis pubis to the urethral meatus, the posterior urethra, and to the anterior bladder wall. The latter two attachments spanned the internal bladder orifice. In addition the triangular ligaments supported the mid urethra as well as delineated its membranous portion. Anterior, posterior, or complete urethroceles occur when any or all of these supporting attachments are or become insufficient.

Function of the bladder is altered whenever the viscus or its outlet becomes displaced, either because the pelvic floor support fails, or the urethral attachments are injured in the latter case with or without strong pelvic floor support. The position in which the bladder is maintained plays an important part because of the transmitted pelvic muscle support and fibrous and urethral attachments.

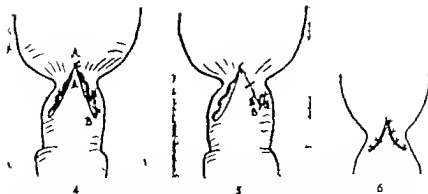


Fig. 4 (Granjon) The inferior flap is reflected upward between the two edges of the incised mucosa. Point A is brought up to A, point B is brought up to B.
Fig. 5. There is an excess of the superior mucosa at the two lateral angles.
Fig. 6. The excess of the mucosa of the external border is utilized for plicating, which increases its width.

because it often results in strictures and mutilating scars. The mucosa covering the occluding membrane from above and below is really a part of the vaginal mucosa. Therefore, as much as possible of this valuable material should be saved. The author reports 6 of his own cases in detail and describes his technique of plastic repair. **WERNER M. SCHAEFER, M.D.**

MISCELLANEOUS

Dysmenorrhea and Ovulation: Correlation of the Effect of Estrogen Therapy on Pain, the Endometrium, and the Basal Body Temperature. LOREN W. HAYS, JOSEPH W. GOLDBERGER, and E. C. HANSEN. *Am. J. Obs. Gyn.* 1947 54: 820.

One of the most striking characteristics of functional dysmenorrhea is its invariable correlation with a pregestational endometriom or an ovulatory type of basal temperature curve. On this basis it has been concluded that ovulation is a prerequisite for dysmenorrhea, and treatment aimed at the suppression of ovulation has been undertaken. The authors have attempted to correlate the response to therapy with various dosage levels of estrogen.

The effects of treatment were studied during 53 cycles of 50 patients. In the evaluation of data, treatment was considered successful only when there was complete relief of pain. In most instances in which there were failures there was partial relief of pain, but the large personal factor which enters into the interpretation of "partial relief" renders these results of questionable value.

In the untreated cycles, 46 biopsies showed pregestational endometriums, all of which were associated with dysmenorrhea. In those women with dysmenorrhea in whom an estrogenic endometrium was encountered no pain was present during that particular cycle. According to basal temperature records all patients showing an ovulatory rise complained of pain.

Progressively larger percentages of patients became pain-free as dosage levels of premarin (estrone

sulfate) or diethylstilbestrol were used, 72.7 per cent were totally pain-free when treated with from 40 to 60 mgm. of diethylstilbestrol.

In order to establish the optimal dosage for the individual patient, the authors conclude that it is advisable to follow treatment with endometrial biopsies or determinations of the basal temperatures.

No gross menstrual disturbances followed the described schedule of estrogen administration, although the dosage given to some patients was relatively large.

The presence either of progesterone or of its physiologic effects is a prerequisite for dysmenorrhea. Although it is initiated by progesterone other details of the pathogenesis of dysmenorrhea are unknown. **JOHN R. WOLFF, M.D.**

The Surgical Treatment of Stress Incontinence in the Female. A Report of 67 Cases. (Příspěvek k otázce chirurgické léčby relativní inkontinence moče u žen. Zpráva o 67 operovaných případech.) JAROMÍR PADOUŠ. *Česk. gyna.* 1947 31: 343.

Relative urinary incontinence or stress incontinence as it is commonly designated in the Anglo-American literature, predominates in women who have borne one or more children. It does not appear immediately but later in life when senile relaxation of the tissues occurs. A certain number of cases of stress incontinence occur however in women who have never borne children.

In the 3½ years, that is 1943, 1944, 1945 and a part of 1946 61 women were operated upon for incontinence. At the end of 1946 a questionnaire was sent out to inquire if the results of the operation had been permanent. There were 47 replies and it is on these 47 cases that this report is based.

Of those who replied, 35 reported that the urinary control obtained at operation had remained complete, while the remaining 12 reported that although control of the urine had been good following the operative correction the incontinence had gradually returned in greater or lesser degree after about a half

struation time but now there was a constant discomfort, especially marked during the menstrual period and predominating on the left side. There was a large tumor in the region of the left ovary which had pushed the uterus over to the right and a smaller mass in the right ovarian region. At operation the ovaries were unrecognizable their place having been taken by tumor masses showing the characteristics of endometriosis. Subtotal hysterectomy and bilateral ovariectomy brought complete relief however some months later the hypogastric pains recurred predominating on the left side they were accompanied by some bleeding. These attacks occurred at the habitual time for menstruation. Examination disclosed a tender mass, the size of a large walnut in the left cul-de-sac. Testosterone (acetestosterone) was started and when 520 mgm. had been administered the mass had diminished to half its original size. The treatment was continued at the rate of 100 mgm. per month and after 2 months no trace of the mass could be found. There was now only a half day's bleeding at the menstrual period and some heaviness in the left leg. Some months later there was no more bleeding and the patient was free of pain.

Histologic diagnosis of the original tumor was typical ovarian endometriosis and the author believes that the recurrent tumor was of the same character. He believes that the efficacy of the male hormone in these cases is established nevertheless there are 3 other methods of treating endometriosis (conservative ablation of the tumor itself, castration and irradiation therapy) and these may be used alone or in combination to fit the exigencies of the individual case.

JOHN W. BREXMAN M.D.

The Surgical Aspects of Endometriosis (Aspetti chirurgici dell'endometriosi) EMILIO MUMFORD. *Arch Ital Chir.* 1947 69 47

Adjunctive to and as motivation for an extensive review of the medical literature with regard to the pathogenesis of endometriosis the author reports 4 cases from his own personal experience.

The first case was that of a 45 year old pluriparous woman who underwent a subtotal hysterectomy for a voluminous fibromyoma of the uterus. During the course of the operation a horseshoe shaped new growth partially encircling the sigmoid colon was uncovered and extirpated together with the involved section of the gut. This new growth consisted of a complex of tubular glandlike structures containing mucus and blood enclosed in a stroma resembling the cell rich stroma of the endometrium and lined with cylindrical epithelium in one or more layers. The tumor growth had invaded the serosa, the subserous connective tissues and the muscularis but had nowhere involved the mucosa of the colon. In this case the theory of Sampson—with reference to an endometrial transplant by way of a reflux of menstrual blood through the tube—as favored by the presence of a fibromyoma of the uterus and a propitious hormonal milieu—seems to find its ideal application.

The second patient a 37 year old multiparous woman had suffered more or less since girlhood from a severe anemizing menorrhoea and a progressive condition of constipation which for the past 8 months had at times amounted to a subocclusion. At operation a firm tumor mass the size of a hen's egg was found to be firmly adherent to the rectum on one side and to the left side of the vaginal vault on the other. The uterus was removed with 2 cm. of the vaginal wall and about 4 cm. of the rectum together with the tumor mass. Here again the histological examination disclosed the characteristics of an endometrial tumor involving the posterior wall of the vagina, the posterior muscular wall of the uterus and the serous and muscular layers of the rectum but nowhere involving the mucosa itself. This condition is explained as a simple spread of the process by contiguity from the original lesions in the genital organs to the rectum, the impetus to proliferation being furnished by the hormonal instability of the period immediately preceding the menopause.

The third case was that of a 40 year old multipara in whom an endometriosis of the myometrium—the so-called endometriosis interna—was discovered in a uterus which had been removed en masse with a right sided pyosalpinx and a left-sided hydrosalpinx. It is mentioned as a possible example of the so-called phlogistic impetus to endometrial development.

The fourth case was that of a 40 year old woman who had never been pregnant. The appendix had been removed when she was 8 years old and the wound had drained and suppurred for a considerable period before healing. Thereafter for 32 years the cicatrix had shown nothing abnormal then it began to pain during the menstrual periods, and later opened and discharged a dark-colored liquid. Finally a bluish black nodule appeared on the outside and continued to increase in size. The nodule, together with about 6 cm. of the scar was excised and histologic examination disclosed the usual complex of apparently interconnected glandlike structures embedded in the typical cell rich stroma of endometriosis. However in addition to the usual picture of endometriosis there was a remarkable finding in this case which the author believes has not thus far been described. This consisted of areas of what appeared to be invasions of young blood vessels and sinuses lying in a loose delicate stroma and lined with the usual flat layer of endothelium. Closely juxtaposed to these areas were others with other blood-containing vessels and sinuses, the lining membrane of which had become thickened until in places the carpeting cells became cubical or even cylindrical in one or more layers, just as in the glandlike structures of endometriosis. In these areas the delicate supporting stroma of loose connective tissue became denser more cell rich and protruded into the lumina in the form of papillary elevations typical of endometriosis. The author did not actually find any intercommunications between the young blood vessels and the mature endometrioid structures, although they often lay side by side and their general

The trigonal muscle smooths down the mucous membrane of the internal orifice but alone does not open the internal orifice and posterior urethra. This action, the author believes, is accomplished mainly by a voluntary downward pull of the anterior perineal muscle.

When the internal orifice sags, most frequently as a result of childbirth damage, although this condition may be congenital or neurogenic in etiology, then a sudden impact such as is caused by a cough or sneeze may cause leakage (stress incontinence).

Residual urine may be found 'back' of urethroceles as a result of imperfect action of the internal orifice region, a sag of the bladder greater than that of the internal orifice, or a spastic internal orifice, with or without a sagging bladder base. Residual urine adds to the frequency of stress incontinence.

A cystourethrocele results entirely from the lowered sagging bladder and internal orifice. Both move forward when the patient voids.

Cytoscopic diathermy to the areas of hyperplastic urethritis and/or dilatation of the internal orifice, or possibly transurethral resection of a glandular hyperplasia or scar contracture at the internal orifice, may give satisfactory symptomatic relief.

In nearly every instance, surgical repair should be performed anteriorly from the urethral meatus and should include repair and strengthening of the pelvic floor.

FARDEAR A. LLOYD, M.D.

The Treatment of Vesicovaginal Fistula; Presentation of 4 Cases Successfully Operated upon (Tratamiento de la fístula vesicovaginal, presentación de cuatro casos operados con éxito). R. VARGAS ZALAZAR. *Arch. Soc. cir. hisp.* Santiago, 1947. 7: 487.

After the patient has been carefully examined to ascertain the localization, extent, and condition of the fistula, the local and urinary infection must be completely eradicated before operation is attempted. During this preliminary treatment, the necessary vesical rest is obtained by suction with an appropriate apparatus, and the general condition of the patient is improved by transfusions and rest. The vaginal route of operation is used for low fistulas which are located in the vesical neck or trigone; for those which are located behind the trigone he uses the transvesical route. In general, he prefers to operate through the vagina because it is easier and the patient is exposed to less shock. The patient is placed in a ventral decubitus position for the vaginal route of operation and in a dorsal decubitus position for the transvesical route.

An incision is made around the fistula, about 0.25 cm. from its border, including the whole vesical or vaginal wall, depending on the route of operation. The two walls are separated by cutting with curved scissors. Immediately the deep plane which carries the small collar of the fistula is seen to retract. This plane is closed with U sutures which invaginate the fistula toward the vagina when the transvesical route is used, and toward the bladder when the vagi-

nal route is used. The suture material is chromic catgut. When the deep plane is completely closed, the edges of the superficial plane are united with perforating U sutures which insure that these edges remain invaginated toward the bladder in the transvesical operation and toward the vagina in the vaginal operation, thus guaranteeing good healing. An indwelling catheter is then fixed with catgut to the labia minora and the suction apparatus is installed for 2 weeks. When the hypogastric route is used, an obstructed Pezzer catheter is also installed to make sure that the apparatus functions well. Sulfonamides and penicillin are given from 2 days before operation to a few days after it.

Four patients were successfully treated by this method. The vesical approach was used in 3 cases and the vaginal approach in 1 case.

RICHARD KIRKEE, M.D.

The Prophylactic Treatment of Operative Gynecological Infections in the Course of Radium Therapy (Sul trattamento profilattico delle infezioni operatorie ginecologiche e delle infezioni in corso di radioterapia). GUINETTE VALLER. *Ginecologia*, Tor. 947: 3: 353.

The author discusses the criteria for the choosing of methods of immunity, chemotherapy, and antibiotics in the prophylactic treatment of operative gynecological infections.

The injection of foreign protein increases the number of leucocytes and phagocytes. Its action is also on the formation of antibodies and the stimulation of the reticuloendothelial system.

The author advocates sulfonamides prophylactically with the following procedure of administration: from 6 to 8 gm. of the drug are given by mouth 24 hours before surgery. On the day of surgery 5 c.c. of a 50 per cent solution are given intravenously. After surgery 6 to 9 gm. of the drug are given every 4 hours until the patient is out of danger or the sulfonamide blood level reaches 15 mgm. With this plan good results were obtained.

Although the author has not had much experience with the prophylactic use of penicillin he cites the following advantages of penicillin over sulfonamides: (1) quick bacteriostatic action, (2) absence of secondary toxic actions which allows a larger dose and prolonged treatment even in poor operative risks, and (3) the greater diffusibility of penicillin makes possible its action on sulfonamide-resistant organisms.

ARTHUR F. CIPOLLA, M.D.

Recurrence of a Bilateral Ovarian Endometriosis Following Castration. Favorable Action of Testosterone (Récidive d'une endométriose ovarienne bilatérale après castration. Action favorable de la testostérone). EMILE DELANNOY. *Gyn. obs.*, Par. 947: 46: 533.

A 42 year old woman, who had never borne children but who had had an abortion at 20 years of age, had been suffering from hypogastric pains for about 15 years. At first the pains appeared only at men-

struation time but now there was a constant discomfort, especially marked during the menstrual period and predominating on the left side. There was a large tumor in the region of the left ovary which had pushed the uterus over to the right and a smaller mass in the right ovarian region. At operation the ovaries were unrecognizable their place having been taken by tumor masses showing the characteristics of endometriosis. Subtotal hysterectomy and bilateral ovariectomy brought complete relief however some months later the hypogastric pains recurred predominating on the left side they were accompanied by some bleeding. These attacks occurred at the habitual time for menstruation. Examination disclosed a tender mass, the size of a large walnut in the left cul-de-sac. Testosterone (acetosterandryl) was started and when 550 mgm. had been administered the mass had diminished to half its original size. The treatment was continued at the rate of 100 mgm. per month and after 3 months no trace of the mass could be found. There was now only a half day's bleeding at the menstrual period and some heaviness in the left leg. Some months later there was no more bleeding and the patient was free of pain.

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picture suggested such communication therefore he does not attempt to maintain that they are a substantiation of the metaplasia theory of R. Meyer. He merely presents several figures and allows others to draw their own conclusions. He hopes that in this manner they will be attracted to contribute to and attempt to further elucidate this question.

JOHN W. BRIDGMAN, M.D.

The Role of Celioscopy in the Diagnosis and Treatment of Sterility and Ectopic Pregnancy (La place d la celioscopie dans le diagnostic et le traitement des stérilités et des grossesses ectopiques) RAOUL PALMER and IRENE JACOBOWITZ. *Rev. fr. gyn. obs.* 1947 43: 3.

The authors have performed about 200 celioscopies without a mishap and with only 11 total or partial failures. The present report is based on the performance of 78 celioscopies during the period from July 1945 to July 1946.

The following technique is applied:

1. The cervix is grasped by a tenaculum and if no uterine pregnancy is suspected a cannula for insufflation is introduced into the uterus. This permits elevation and movement of the uterus to a position of anteversion, to open the retrouterine space for exploration of the tubes and ovaries. At the same time, this measure permits of uterotubal insufflation or salpingography in the course of the celioscopy.

2. A special needle is pushed through the abdominal wall in the left hypochondrium to produce a pneumoperitoneum as preparation for a paracentesis with a trocar.

3. Under local anesthesia, a small skin incision is made 4 cm. below the umbilicus; a trocar is introduced through this incision and the stylet is replaced by the peritoneoscope.

4. The patient is placed in Trendelenburg position to rid the pelvic cavity of intestinal loops and an

assistant manipulates the uterine cannula to elevate and tilt the uterus anteriorly. Now the uterus, the adnexa, the cul-de-sac and the neighboring organs can be explored.

5. If adhesions hinder the view or have to be severed for therapeutic purposes, a second trocar can be introduced to admit a galvanocautery for cutting the adhesions.

6. At this stage insufflation of the tubes or hysterosalpingography can be added to the celioscopy to verify the permeability of the tubes.

Conditions which can be recognized by celioscopy include normal pregnancy, uterine fibroids, retro-uterine adhesions which prevent the correction of a retroflexion pathology of the ovary (cysts, endometriosis, periovaritis), tubal pregnancy, hydrosalpinx, tuberculosis of the tubes, and pathology in the cul-de-sac. The neighboring organs (bladder, pelvic colon, cecum and appendix) also may be visualized and investigated; however the exploration of the appendix is often difficult and should not be enforced.

In cases of sterility celioscopy is indicated only as a last resource. Examination of the spermatozoa, of the cervical mucus, and salpingography should precede it. There is, however, one exception to this rule. If a palpable mass of the adnexa is present, insufflation or salpingography are contraindicated because they may cause a flareup of an old pyosalpinx. Also if there is a suspicion of genital tuberculosis, no insufflation should be attempted. In these cases, celioscopy should be done first, and only if an inflammatory lesion has been ruled out should the permeability of the tube be tested by means of salpingography.

Ectopic pregnancy reveals an unmistakable picture in celioscopy and in doubtful cases, can be easily differentiated from other conditions with similar clinical symptoms, especially a ruptured corpus luteum cyst.

WILHELM H. SCHULTZ, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Preservation of the Threatened Pregnancy with Particular Reference to the Use of Diethylstilbestrol
GORDON ROSENBLUM and EUGENE MELINKOFF
West. J. Surg. 1947 55 597

One of the greatest obstetrical problems confronting the clinician today is that of abortion and premature labor. It has been estimated that from 20 to 30 per cent of human pregnancies terminate by spontaneous or induced abortion. This problem is made even more profound when the therapeutic measures available are surveyed. With this in mind the authors have analyzed the existing forms of therapy which are available today.

1. The conservative school of therapy consists essentially of bed rest and sedation. This form of therapy is difficult to evaluate because of the lack of control studies, but the general tendency is to minimize the value of rest in the prevention of abortion.

2. The vitamin school of therapy consists essentially of the administration of vitamin E. Successful results have been reported in as high as 80 per cent of treated patients. In general there is no real agreement as to its value and the prevailing thought is to minimize its value.

3. The endocrine school of therapy has high regard for thyroid as a therapeutic agent but thyroid cannot be evaluated thoroughly because of the lack of control studies. The results of steroid progestogens are variable and figures pertaining to its use, with success vary from 18 to 90 per cent; some observers have claimed 67 per cent success with steroid progestogens and estrogens, but here again there is no unanimity of opinion. Steroid estrogens alone have been used in the treatment of pre-eclampsia and diabetes in pregnancy but evaluation is not possible because of the lack of controls.

The authors present a series of 95 cases of threatened abortion, habitual abortion, and threatened premature labor treated with bed rest, sedation with barbiturates and diethylstilbestrol 5 to 200 mgm daily. The following statistical results were obtained.

Of 81 cases of threatened abortion, 71 patients carried to term, 10 cases of habitual abortion were encountered; of these 5 carried to term, there were 4 patients with threatened premature labor, 3 of whom carried to term. These results are more favorable than any which the authors have been able to achieve with other forms of therapy.

The toxic effects were mild nausea and pigmentation of linea nigra, congestion of the breasts and darkening of the areolae of the nipples.

Sixteen of 18 patients who had been sterile, carried to term.

J. ROBERT WILSON, M.D.

The Late Toxemia of Pregnancy: The Number One Obstetrical Problem of the South. ROBERT A. ROSS.
Am. J. Obs., 1947 54-733

The problem of the 'ill-fed, ill-clothed and ill-housed' is not new in the South nor is the menace of the toxemia of pregnancy. That these apparently diverse statements are related and pertinent is not too difficult to demonstrate. With no sharp demarcation, there are 3 dietary groups of patients in North Carolina: (1) the intelligent, economically capable, (2) the fairly co-operative adequately nourished and (3) the uninformed, improperly nourished, medically inarticulate group of patients. Toxemia is rarely found in the first two but it is the prime factor in maternal mortality in the last.

The author analyzes 11,000 deliveries in Duke Hospital, Durham, North Carolina, from 1931 to 1946. His criteria for the eclamptic state are blood pressure 160/100, albuminuria, increased blood urea acid and lowered CO₂ combining power associated with other usual findings. Included in this group were 303 patients with convulsions and 106 patients without convulsions. Four of the patients in the latter group who later developed convulsions died. The percentage of deaths in the total group of eclamptic patients was 11.1 per cent, and the percentage of deaths among those with convulsions was 15.2 per cent. Nearly 1,500 patients had 'other toxemia of pregnancy' (hypertensive and cardiovascular renal conditions) and the total mortality in this group was 3.7 per cent. The total number of deaths from 'late toxemia' was 80 (4.5%). These 80 deaths represent 38.2 per cent of all of the deaths in obstetric patients.

The lack of prenatal care in this series of cases, as in other reported series, stands out. Thirty-five of the patients who were in the eclamptic state when first seen died. Of these 19 had not seen a doctor during the pregnancy until convulsions occurred; 5 patients had made one visit to a doctor, none had made three visits; 1 had 'fair' prenatal care and only 1 had care that was good.

On checking the localities from which the toxemic patients had been referred and on reviewing the State morbidity and mortality statistics it was found that the areas in which eclampsia occurred most often were the same areas in which a large percentage of the cases of pellagra and similar diseases occurred. The patients admitted in eclamptic convulsions came from the same group who subsisted on a diet similar to that of pellagrins. The diet is grossly deficient in all the vitamins, especially vitamins A, C and D as well as in the minerals and proteins. In this group the dietary very likely had been deficient both in the quantitative and qualitative aspects.

The author discusses the general purposeful efforts being made toward better prenatal care throughout this area.
JOHN R. WOLFF, M.D.

Fatal Eclampsia. A Clinical and Anatomic Correlation Study. GEORGE T. C. WAY. *Am J Obst* 1947 54: 928.

The author presents a summary of all fatal cases of eclampsia which were examined at autopsy in the Department of Pathology, Duke Hospital, Durham, North Carolina, during the period from 1930 to 1946. The clinical histories and postmortem findings are correlated. An attempt is made to correlate the observed lesions with some current hypotheses concerning the pathogenesis of eclampsia.

By summarizing the essential clinical aspects of these fatal cases of eclampsia, the author creates a composite picture of the average patient.

If a primipara, the patient is about 19 years of age, and has had at least one convulsion prior to admission. During the few days or weeks preceding admission she has experienced increasingly severe headaches and edema. She may also complain of one of the three following symptoms: recent nausea and vomiting, visual disturbances, or abdominal pain. Physical examination reveals that she has hypertension and generalized edema, and is in a comatose condition. Tachycardia and pulmonary edema may or may not be present.

If a multiparous patient, she is about 30 years of age and has had the signs and symptoms of pre-eclamptic toxemia during a previous pregnancy. There is one chance in three that she has had a previous attack of eclampsia. She, too, is comatose and demonstrates hypertension and edema. In all probability she has had convulsions prior to admission.

Both patients will demonstrate a slight increase in blood nonprotein nitrogen and a definite increase in blood uric acid. Total plasma proteins will be reduced, and the albumin-globulin ratio will be markedly reduced. Death will ensue in about 2 days.

Anatomic study reveals the liver to be the seat of a important pathologic change. The lesion most frequently encountered is a focal hyaline or fibrinoid necrosis of the liver cells, usually but not necessarily in the periportal areas and usually of recent origin, with or without hemorrhage.

Renal lesions have been divided into three stages which represent steps in the development of permanent renal change: first stage lesions with glomerular but no arteriolar alterations were typical in 33 per cent of the cases; second stage lesions characterized by thickening of the arteriolar wall, were observed in 48 per cent of the cases; third stage lesions similar to arteriolonephrosclerosis characterized 18 per cent.

Eleven patients demonstrated hemorrhage and necrosis in the adrenals. In 5 of these the condition was classified as severe. An attempt has been made to correlate these lesions with vascular collapse prior to death.

Additional lesions were found, as follows: pneumonia, focal necrosis of the myocardium, pancreas

and brain, acute endometritis, cerebral hemorrhage, cystitis, acute mastitis, cerebral arteritis and arteriolitis.
JOHN R. WOLFF, M.D.

LABOR AND ITS COMPLICATIONS

Low Cesarean Section: the Treatment of Choice in Placenta Previa (La césarienne basse; traitement chirurgical de choix du placenta prævia). J. N. MULLER. *Rev. f. gyn. obs.*, 1947 43: 236.

The author reports a series of 199 cases of placenta previa which were observed during the periods from 1919 to 1939 and from 1946 to 1947. Fifty of the patients in this series were treated by low cesarean section, and only 1—a patient who had lost a great amount of blood before the operation—died on the operating table.

The author presents a detailed statistical analysis of these cases which shows that the maternal mortality as well as the fetal mortality rate is lowered considerably by low transverse cesarean section as compared with other obstetrical procedures such as rupture of the membranes, podalic version, and bag induction.
WILHELM M. SCHMIDT, M.D.

An Analysis of 416 Consecutive Cesarean Sections. RICHARD B. NICHOLS and WILLIAM C. ANDREWS. *Am. J. Obst* 1947 54: 79.

The authors analyze a consecutive series of 416 cesarean sections done during a 12 year period from January 1, 1935 through December 31, 1946. The cases are considered in two groups. The first 275 in number included patients who came directly as private patients, not referred by any physician, or who were referred early in pregnancy and so were given prenatal care by the authors. The second group of 141 patients were referred either late in pregnancy or in labor or the emergency had already existed when first seen. The authors were not able to study the majority of the cases in this group before the advent of labor.

The purpose of this article was to evaluate the results, insofar as they applied to the authors regarding mortality, morbidity and fetal deaths.

In regard to indications, disproportion (in 211 cases) provided the largest number both in the personal group (138) and in the referred group (73). The disproportion was determined by roentgenography and the various degrees of disproportion were ascertained, including contracted midpelvis and outlet. Roentgenograms were used extensively in estimating the maturity of the fetus, the location of the placenta, the number of babies, and in detecting malformation of the fetal skeleton and in some cases the position of the presenting part. The authors believe that this plan has eliminated severe complications associated with prolonged labor, uterine inertia, and hemorrhage, which have contributed so largely to both mortality and morbidity of the mother and death of the child.

Placenta previa and premature separation of the placenta furnished the indication for cesarean section

in 61 cases, although all these cases were not sectioned. All patients with central placenta previa were sectioned. Some patients with marginal and lateral placenta previa were sectioned because of the amount of bleeding and the condition of the cervix. A similar plan for premature separation of the placenta was used.

Eclampsia, pre-eclampsia and toxemia. A small group (12) of patients with these conditions was delivered by cesarean section. Eclampsia and/or pre-eclampsia were not considered indications for section, rather cesarean section was regarded as the method of terminating the pregnancy in selected cases and then only when they were adequately treated. 94.5 per cent of the sections were cervical in type.

Fetal mortality. There was an uncorrected fetal mortality of 5.8 per cent (10) in the personal group and of 1.4 per cent (20) in the referred group.

Maternal mortality. In 3,035 deliveries performed during this 12 year period there were 9 maternal deaths 6 of which were associated with cesarean section. Of the 9 deaths 2 were in the personal group and 7 were in the referred group. Of the 6 associated with cesarean section, 4 were in the referred group. The deaths associated with cesarean section include 2 postmortem sections both in the referred group which are included for completeness of review. The first mortality in the personal group was due to sepsis and occurred before the advent of sulfonamides, penicillin or other antibiotics. The second mortality in this group was due to pulmonary embolism, which the authors believe is a surgical risk faced by any patient undergoing surgery. In the referred group all 4 deaths occurred in women who had no prenatal care. They were primarily pre-eclamptic or eclamptic, although 1 died secondarily of hemorrhage.

The authors conclude that cesarean section per se is not the chief cause of maternal death as it has been thought to be, but rather that the obstetric complications cause death in most cases this applies in general to the fetus. It is also observed that in obstetric patients who are cared for by proper prenatal study and individualization the maternal and fetal mortality is definitely reduced.

JOHN R. WOLFF M D

PUERPERIUM AND ITS COMPLICATIONS

Postabortion Phlegmonous Gangrene of the Uterine Cervix (Phlegmon gangræneux post abortum du col utérin). M. MAYER, A. GRAMON and BEAUCHAMP. *Gyn. obsit. Par.*, 1947 46 537

A 32 year old woman had been pregnant for 2½ months when attempts were made to produce artificial interruption. Seventy two hours after the last attempt, chloroform was administered and the uterus was cleaned out digitally and with a large blunt curette. At this time the patient had fever and the body of the uterus was enlarged and tender but the cervix seemed perfectly normal. Five units of posterior hypophyseal preparation were injected into the

anterior lip. Two days later despite absolute bed rest, an icebag to the abdomen and sulfonamides the patient was extremely ill and the uterine cervix had increased in size so that it apparently filled the entire lower portion of the pelvic cavity. The abdomen was opened and the uterus removed, but the patient did not rally from the operation.

A few cubic centimeters of fetid fluid were found in the peritoneal cavity which on culture yielded the *Clostridium perfringens* and a streptococcus. Macroscopically, the removed specimen presented what appeared to be a practically normal uterine corpus perched upon an enormously enlarged cervix. The cervical tissues presented a lardaceous appearance and seemed to be shot through with small cavities filled with clot and bacteria, exuding a fetid fluid. The mucosa of the cervical canal appeared to be gangrenous. Microscopically the mass of cervical tissue was found to be composed of amorphous filaments staining blue with hematoxylin. Most of the cavities were lined with endothelium and contained deteriorating red blood corpuscles and masses of bacteria.

The authors believe that the infection of the hypophyseal preparation played an essential role in the development of this condition, and they recommend that in future this drug should not be used following curettage in this manner particularly in cases in which the ovum as a whole or in part has remained in the dilated gaping cervix for a more or less prolonged period of time. JOHN W. BRENNAN M D

Rupture of Purulent Puerperal Ovaritis (La rupture des ovaires purpures puerpérales). P. TAILLAT and A. NORRIS. *Gyn. obsit. Par.* 1947 46 161

Eight days after a spontaneous abortion in the fourth month of her second pregnancy a patient suddenly developed hyperpyrexia, violent pains and boardlike rigidity of the abdominal wall. Laparotomy revealed a ruptured abscess of the right ovary and the patient died one day after intervention.

The authors report 3 similar cases from the modern or more recent literature and 12 cases from older literature. All but one of these patients died of generalized peritonitis due to ruptured ovarian abscess following abortion or delivery. The only patient on record who survived was a quadripara 42 years of age who was operated on 4 months after delivery for an alleged appendiceal abscess. The appendix was not found at that time and the abscess was drained by a rubber tube. As the sinus persisted a second operation was performed 6 months later and an ovarian abscess the size of a tangerine was found and removed.

The clinical course and pathogenesis are discussed briefly. Invasion of the ovary may occur by hematogenous or lymphatic spread, or from the tube. The site of the abscess is usually in the center of the organ, the organisms causing the abscess being mostly streptococci. The characteristic clinical picture is low grade fever following abortion or delivery. After a free interval of longer or shorter duration, a second

episode develops with high fever, abdominal pains, metrorrhagia, and leucorrhoea. The ovary may rupture into one of the neighboring organs (rectum, vagina, or bladder) or into the peritoneal cavity, rupture into the rectum is of comparatively good prognosis. Rupture into the peritoneal cavity led to fatal generalized peritonitis in all cases on record.

WILHELM M. SOLMITS, M.D.

Paralysis of the External Popliteal (Common Peroneal) Branch of the Sciatic Nerve in the Puerperium (*Les paralysies du sciatique poplite externe dans le post partum*). PAUL TRILLAT and MARCEL DUMONT. *Gyn. et Obst. Par.* 1947 46 4 3.

The authors report 6 cases of peroneal nerve palsy observed at the Obstetrical Clinic of Lyon, France in recently delivered women.

They reviewed the anatomy of the sacral plexus and its relationship to the bony pelvis. The 6 cases were discussed in some detail. Four of the patients were primiparas and 2 were multiparas. Three of the patients were delivered by midforceps. In 2 of the spontaneous deliveries the infants were large (4,000 gm. and 3,840 gm.) and both of the mothers had slight pelvic contraction. One patient, a para, with a history of 5 previous normal deliveries, had a spontaneous delivery of a 3,000 gm. baby through a normal pelvis, but nevertheless developed paralysis.

The authors discussed the hypothesis of Morgan and Thomson who attributed the paralysis to direct compression of the peroneal nerve while the patient was in the lithotomy position during delivery. As some of the patients in the cases discussed by Trillat and Dumont were delivered spontaneously and were never placed on a gynecologic table the authors rejected this mechanism as the sole cause of nerve compression.

They emphasized several interesting clinical points. All of their patients had definite pain referred to the distribution of the peroneal nerve. At the time of delivery the patients complained of cramps, formication or burning, beginning in the calf and radiating to the toes. In one case, severe pain was felt in the buttocks. In all of their cases the pain was unilateral. The paralysis was frequently not observed until the patient began to walk and foot drop was noted. Spontaneous cure usually occurred in 2 or 3 weeks. One patient had paralysis for 6 months, and some patients have been reported as having paralysis which persisted for several years.

The authors concluded that paralysis of the external popliteal branch (common peroneal) of the sciatic nerve occurring in women recently delivered are probably the result of compression of this nerve inside the pelvis when there is a high division of the sciatic nerve. The typical case is that of a primigravida undergoing a difficult delivery, in the course of which it is necessary to apply forceps on a head arrested at the superior strait or in the hollow of the pelvis in a posterior occipital presentation. The authors think that vitamin B deficiency predisposes to such paralysis.

CRAIG W. MECKLER, M.D.

NEWBORN

A Premature Survival Index and the Conduct of Premature Labor. A. LOUIS DIFFER, HERMAN W. JOHNSON and J. L. CONDELLINOT. *Am. J. Obst.*, 1947 54: 1004.

There is today no unanimity of opinion as to precisely what constitutes a 'premature infant,' no standard being universally accepted. The authors review basic definitions for prematurity and for abortion. Various individual criteria in common use for the diagnosis of prematurity are discussed and reasons given for their inaccuracies when employed separately. A 5 point premature survival index is offered as a means of overcoming inaccuracies in individual criteria and is applied to 23 premature newborns.

The index was obtained by adding gestation in weeks, weight in ounces, crown-heel length in inches, head circumference in inches, and chest circumference in inches, and then dividing the total by five. This resulted in indexes ranging from 19.2 to 25.7 for the infants discussed. The authors suggest that a combination of a larger number of factors of the small premature infant should produce less inaccuracy in the diagnosis of prematurity and in prognosticating the probable outcome than has thus far been possible with any of these factors used alone. The assumption is that the inaccuracies in single factors will tend to be equalized when combined with each other. The authors believe that after further experience they will be able to say that every premature infant born alive in good condition with an index of at least 21 should be reared. Those with an index below this figure need not be considered hopeless. It should be possible to determine probable survival rates for each group below this level, in the absence of congenital anomalies, obstetric accidents, individual maternal variations, and maternal diseases.

Suggestions for the obstetrician's contribution in reducing the premature infant mortality rate are given. These include avoidance of analgesia after the onset of true labor in the period of prematurity, the use of local or regional anesthesia for premature delivery, preservation of the integrity of the fetal membranes through the second stage of labor, maintenance of the maternal-fetal circulation as long as possible, and the prophylactic use of chemotherapy in premature labor.

JAMES R. WOLFE, M.D.

Low Maternal Mortality with Persistence of Hemorrhage as the Chief Cause of Death; An Analysis of Puerperal Deaths in Brooklyn during 1946. CHARLES A. GORDON. *Am. J. Obst.*, 1947 54: 1 38.

In 1946 there were 57 deaths in Brooklyn which were assigned to puerperal causes by the Bureau of Records and Statistics of the Department of Health of the City of New York to give a maternal death rate of 8.7 per 10,000 live births.

Death was due to ectopic pregnancy in 2 cases, because of failure of diagnosis. In 4 cases a abortion had

been induced with perforation of the uterus and in fetal injury in 2 cases in 2 other cases in which hemorrhage was profuse for several hours death was finally due to infection.

Officially 12 deaths were considered due to toxemia 3 more were found in the infection group and 1 death in the abortion group. Prenatal care was inadequate in all but 2 cases. In 3 cases hemorrhage was said to have been considerable although death was due to eclampsia. Convulsions occurred in 9 cases. Cesarean section was performed 5 times in 3 cases after convulsions.

Included in the infection group of 12 cases were 3 deaths due to cardiac disease since death had been attributed to pulmonary embolism. Altogether embolism was mentioned in 10 of the 12 cases assigned to infection. A case of eclampsia was included with 3 cases of death shortly after delivery in which dyspnea, paroxysmal cough and cyanosis point to anesthetic as the cause of death. In 2 cases clinical embolism occurred on the third and fifth days in women who were up and about.

Only 8 deaths were formally assigned to hemiarthrectomy. In 2 of the 3 cases of postpartum hemorrhage hysterectomy was performed after other measures had failed. Hemorrhage was the actual cause of death however in 6 cases otherwise tabulated as abruptio placentae rupture of the uterus and probable rupture of the uterus. As much as 8 units of plasma were given to one patient before blood was procured just prior to hysterectomy. In another case of postpartum hemorrhage bleeding continued for 3 hours in bed while 4 units of plasma were administered. The uterus was continuously massaged but not explored. Hemorrhage was the actual cause of peripartal death in 35 per cent of the 57 cases.

Cesarean section was associated with death in 14 of the 57 cases. For the last 10 years approximately one third of the maternal deaths exclusive of those early in pregnancy have been associated with cesarean section. Not only do the indications for this procedure need close examination but a high standard of performance is required with attention to every detail.

It is not possible to learn the true importance of anesthesia from the statistics of maternal death. Even though death is stated to have been directly due to aspiration of vomitus anesthesia is not tabulated as a cause of death. Anesthesia was an important cause of death in Brooklyn in 1946. Deaths may be readily separated into three groups as due to the toxic action of the anesthetic drug, to aspiration of phlegm, and to atelectasis, whether from aspiration or not. The records of 8 cases are given.

JOHN R. WOLFF M.D.

Respiratory Difficulties of Infants at Birth (Les troubles respiratoires de l'enfant à la naissance) P. LANTIER, J. L. RIBADEAU DUMAS, HÉRAUX and J. DEBRAY. *Jr méd chir thorac.* 1947; 1: 230.

The authors discuss the causes of respiratory failure in infants during childbirth. The mechanism of

intrauterine aspiration of amniotic fluid and of the establishment of normal respiration at birth is reviewed. Pneumographic findings and roentgenographs of fetuses with normal respirations and of fetuses with bronchial obstruction are shown.

In cases of persistent bronchial obstruction the fetus makes desperate respiratory efforts. The pulmonary effects are congestion bronchoalveolar distention bullous emphysema hemorrhages and arterial and venous thromboses.

Pneumothorax of the newborn was described by Runge in 1878. Such pneumothorax is not rare in the authors' experience. Difficult delivery or rupture of a small pulmonary abscess into the pleural cavity is the usual cause. The diagnosis is often missed because dyspnea and cyanosis are commonly observed in slow labors. Radiologic examination readily discloses the existence of pneumothorax but must not be confused with aeration of the clear zone of the normal lung. These pneumothoraces are often not noticed and their prognosis is good.

The term *angioalveolitis* is applied to those severe respiratory conditions characterized by such vascular effects as dilatation of the vessels edema of the endothelium. These conditions associated with cerebral hemorrhages and multiple visceral hemorrhages were frequently found in stillborn infants.

Pulmonary infections of the fetus during birth may be the result of aspiration of septic fluids or septicaemia. Bacterial invasion is favored by the length of labor after rupture of the membranes. Contamination of the ovum with aspiration of infected amniotic fluid is mentioned as a rare occurrence. Infection of the amniotic sac occurs by the ascending route from the vagina. Pathologic conditions in the vagina produce rhinopharyngitis congenital otitis and bronchopneumonia which appear at birth or in the days following birth.

The infection sometimes begins peripherally, for example as pulmonary lesions secondary to umbilical infection. Once the authors' attention had been attracted to these conditions, they were found much more frequently and at autopsy pulmonary lesions were revealed in 75 per cent of the cases. The lungs react differently to infection via the bronchi and by way of the blood.

Infection by aspiration of septic liquids is favored by slow and lengthy labor. It occurs by aspiration of amniotic fluid at the moment of birth. Examination of the lungs of stillborn infants whose mothers had long infected labors revealed pulmonary congestion with masses of bacteria in the bronchi and alveoli. There was no doubt that the infection had taken place by way of the respiratory tract. It is a state of bacterial invasion and of congestion.

It is possible to find typical bronchopneumonia in the fetus and in the newborn infant. The lesions are variable pneumonic in type with congestion, edema and hemorrhage. Usually the infant is born dead but sometimes it survives. The symptoms may be

slight or very marked. Radiography gives valuable information in such cases. The prognosis is usually poor but some infants have been saved by penicillin therapy. The pulmonary lesion may result in the formation of little abscesses, the rupture of which into the pleura causes pneumothorax and pyothorax. Acute obstruction of the bronchi results in edema and hemorrhage.

Infection of the lungs by way of the blood stream may take several forms. Purely congestive types occur without bacteria. Septicemic lesions with bacterial emboli, miliary infarcts, miliary abscesses and especially, hemorrhagic infarcts may be found. Colonies of micro-organisms abound in the lumens of the smaller blood vessels. Streptococci are most frequently found but staphylococci are not rare. In the course of infections of intestinal origin, the colon bacillus is the most common cause. After birth, the pathogens are more varied depending on the environment.

Finally there are pulmonary lesions which result from the swallowing of particles of food. The infant vomits regurgitates, and allows the alimentary liquids to enter the bronchi. This causes a form of chemical softening of the lungs. The lung tissues are pale grey or brownish black with an acid gastric odor. These infants usually have severe dyspnea and high temperatures, and die within a period of 24 hours.

The avoidance of these pulmonary complications depends in part on better obstetrics, as the great majority are the result of long and difficult labors. The second factor is clearing of the bronchi, and too much importance cannot be attached to this factor. The catheter should be carried as far as possible in the airway. The usual methods of resuscitation should be used. Penicillin therapy or sulfanilamides are beneficial in the presence of infection.

CHARLES W. MUCKLE, M.D.

Studies in Erythroblastosis Fetalis. Activation of the Incomplete Rh Antibody by the Blood Serum of Full Term and Premature Newborn Infants. ERNEST WIKERSKY, MITCHELL I. ROBIN, and LILIAN M. YOUNG. *J Lab Clin M* 947 33-350

The failure to demonstrate Rh antibodies in the majority of sera obtained from mothers who have given birth to erythroblastic children was in a large part explained by the discovery of a second type of antibody variously called the "incomplete antibody" or "blocking antibody." This new type of antibody has been shown to agglutinate Rh positive cells provided that albumin solution or undiluted sera replaces saline solution as the diluent. The authors' experiments deal with the characteristics of sera in prenatal and postnatal life with regard to its capacity to actuate the incomplete Rh antibody.

Anti-Rh sera containing incomplete antibodies of low or average titer were activated by normal adult sera, but only slightly or not at all by normal cord sera. In contrast, other Rh sera such as those supposedly produced by immunization of volunteers and

containing incomplete antibodies of fairly high titer were activated by both normal adult sera and normal cord sera. However, even in the latter instances the average normal cord sera proved to be of somewhat weaker potency than the average normal adult sera.

Cord sera of premature babies are characterized by a definite weakness in activating potency which depends upon the age of the babies. The activating power of sera therefore depends upon a maturation principle which is subject to considerable individual variation. Experiments are described to demonstrate that the maturation of the activating capacity may continue after birth.

It seems reasonable that a relationship exists between the capacity of the baby's serum to activate the incomplete antibody and the clinical picture of erythroblastosis. The development of this maturation factor might explain the fact that clinical manifestations become evident only during the second part of pregnancy. The rapid increase in activating potency after birth may explain why some babies are born apparently normal and develop clinical manifestations after birth.

The question of treating erythroblastic babies with transfusions of adult blood deserves critical thought. Even though it is not possible as yet to prove an increase of activating potency in the baby's blood plasma following the injection of whole blood, the conclusion that adult plasma given to erythroblastic babies might possibly increase the danger of intravascular agglutination and hemolysis seems inescapable.

GEORGE BLUMBERG, M.D.

Studies in Erythroblastosis Fetalis. Investigations on the Detection of Sensitization of the Red Blood Cells of Newborn Infants with Erythroblastosis Fetalis. ERNEST WIKERSKY, MITCHELL I. ROBIN, LILLIAN M. YOUNGER, and LILIAN BLUM. *J Lab Clin M* 1047 33-1339.

The presence of free circulating Rh antibodies in the umbilical cord serum of an erythroblastic baby is a good indication that the baby has been sensitized. However many erythroblastic babies show either no such antibodies or only antibodies of low titer. In the absence of demonstrable Rh antibodies in the cord serum, the laboratory evidence of the baby's sensitization rests upon the demonstration of sensitization of his red blood cells.

A simple technique for the demonstration of sensitization of the red blood cells in an erythroblastic baby is described. Agglutination occurs when the packed blood cells of an erythroblastic baby are suspended in normal adult serum. This test can be carried out either in test tubes or on microscopic slides, the use of the latter proving more sensitive. The results obtained from this test indicate that the baby's cells are sensitized by the incomplete type of Rh antibody which does not cause agglutination in saline solution, and only slight agglutination, if any in cord serum.

In an experiment it was found that the addition of increasing amounts of adult serum to cord serum re-

sults in mixtures which have an increasing capacity to agglutinate the sensitized cells of a baby as measured by the technique described. However in contrast to these experimental results, blood samples obtained at regular intervals during an exchange transfusion failed to produce any visible agglutination of the baby's cells.

Some practical aspects concerning the validity and specificity of Rh type and blood group determination of erythroblastotic babies as well as the treatment of these babies by blood transfusion, are discussed.

GEORGE BLINCK, M.D.

Diarrhea of the Newborn. STEWART H. CLIFFORD
England J M 1947 237 969.

The author believes there has been a great increase in hospital deliveries in the past 10 years. Statistics from the Boston Lying In Hospital for the period from 1935 to 1945 show a decrease in home deliveries to almost zero about the same number of ward deliveries and a marked increase in private deliveries.

An all time low maternal mortality apparently justifies the public's belief that the maternity hospital is the safest place to have a baby but the author believes it must be proved whether or not it is the safest place for the newborn.

The literature on epidemic diarrhea has appeared only during the past 25 years and coincides with the shifting of deliveries from the home to the hospital.

Many factors have contributed to the increased hazard to the newborn infant in the hospitals. Increased birth rate and increased numbers of hospital deliveries have led to serious overcrowding in nurseries. Shortage of personnel has led to breakdowns in nursery and formula room technique. Adequate space is often not provided for nurseries and the space provided is often left over space wholly inadequate for the number of bassinets required.

The syndrome described as epidemic diarrhea of the newborn is not one pathologic entity but a miscellaneous group of cases of various etiologies known and unknown bound together by the common symptom of diarrhea. The reported epidemics can be divided into three groups. The first group shows evidence of bacterial origin the infecting agent enters the nursery via an adult carrier and reaches the infant by the fecal-oral route through a break in nursery or formula room technique. Several reports of epidemics are reviewed showing several organisms as the causative agents. In most of the epidemics there were epidemics of diarrhea in the local population contaminated milk supplies, or the mothers or nurses had either diarrhea or the organisms cultured from them were common to the infants affected.

Newborn infants are very susceptible to these infections and are extremely vulnerable because the attendants who feed them and handle the bottles and nipples also handle the excreta. Many epidemics can be traced to nursery personnel through faulty technique.

The second group includes those in which a virus is the agent or is strongly suspected. Several epidemics

were reviewed. In some of these there were also local outbreaks of so-called "gastric influenza" in the community. In some of these cases the stools were filtered and passed through young calves who also developed the disease. In some epidemics no specific agent was found although the infants had low white cell counts and did not respond to chemotherapy. The lack of a relatively simple technique to identify the virus of the disease is the greatest handicap to further progress. The method of growing the virus in newborn calves is of limited usefulness.

The third group includes those cases in which no virus can be identified and none of the bacterial pathogens are found. This group constitutes by far the largest one reported by the public press and public health officials. Several epidemics are reviewed and in them gross breaks in nursing technique are uncovered.

The prevention of epidemic diarrhea depends on strict nursery and formula room technique and the co-operation of epidemiologic and bacteriologic experts.

There are published standards of practice which if followed by all nurseries would go a long way toward removing the hazard of epidemic diarrhea in the newborn. It is disastrous to temporize with these diseases.

BYRON F. HESKETT, M.D.

MISCELLANEOUS

Considerations on Obesity and the Gravidopuerperal State (Consideraciones sobre obesidad y estado puerperal) AMARCO STANLEY. Obis gin lai Amer., 1947 3 393.

The marked proportion of parturient women in Uruguay weighing more than 100 kgs. is explained by a diet rich in starches, sugars and fats coupled with the tendency to a sedentary existence. The author justifies the fact that his arguments are based upon clinical impressions rather than upon statistics based on the material under his personal observation by stating that he does not trust these figures too much since they arise from a very special clientele. However he agrees with Professor Tureme who in his article on the subject of the "distocia anular" (Anales de la Universidad Montevideo 1930 38) emphasized the importance of the consideration of adiposity which arises from endogenous causes tends as a rule to sterility however females with the exogenous variety of obesity do not seem to be relatively less fertile than the corresponding females of normal body weight.

The diagnosis of pregnancy in enormously obese women is not only difficult in the majority of cases but is at times practically impossible requiring in the first half of pregnancy every assistance at the disposal of the medical laboratory and in the second half of pregnancy rendering indispensable the aid of roentgenology. Especially difficult in these cases may be the detection of the presence of multiple pregnancy.

Adding their quota to the uncertainties of obstetrical management are (1) the tendency to gigantism in the fetus (especially in the cases of hyperglycemia or actual diabetes) and (2) the effects of the laws of Duncan, Hecker and Wernich postulating an increased fetal size and weight with the advancing age of the mother and with each succeeding pregnancy. Especially deceiving is the history of perfectly eutocic previous deliveries when the patient was not so obese. In many of these patients a perfectly physiological childbirth is encountered however when dystocia does arise it creates a serious obstetrical problem. Not only is the occurrence of the difficulty almost unpredictable, but when it does arise it is apt to demand special skill and knowledge on the part of the medical attendant. The usual disturbance in the progress of the labor is one of engagement and descent. Later the problem of the so-called "shoulder dystocia" (gigantic fetus) may arise. Of course cases have been reported in which the masses of fatty tissue in the pouch of Douglas would seem to have acted as a forelying obstruction to the descent of the presenting part, and the engagement is frequently delayed by the weakness of the fat-infiltrated uterine musculature however the delay in progress of the fetus into the pelvis is also frequently the result of tonic uterine contraction demanding relaxant measures rather than oxytocics. This contracted state of the uterus (annular dystocia) has frequently been mistaken for uterine inertia.

The author believes that every pregnant woman weighing more than 100 kgs. should be hospitalized and subjected to special study. Failure to recognize the necessity for intervention in time, in dystocia is a sin of omission but there is also the possibility of the other extreme the organic laxity of the obese person must always be kept in mind and the hazards of surgical intervention should be given earnest consideration.

JOHN W. BRECKMAN, M.D.

Obstetrical Accidents of Electrocoagulation of the Cervix (Les accidents obstétricaux de l'électrocoagulation du col utérin) HENRI VERMELIN. *Rev. f. gyn. obst.*, 1947, 4, 61.

The author analyzed the effects of electrocoagulation of the cervix in a series of 26 patients. Six pa-

tients were pregnant when electrocoagulation was practiced, and 3 of them aborted. Twenty patients were electrocoagulated before their pregnancy commenced.

Of the 21 patients who carried their pregnancies to term, 6 were delivered without difficulty. Nine patients had labors lasting more than 24 hours and digital dilatation was necessary 15 times. In 2 cases digital and instrumental dilatation was unsuccessful. In 3 cases total occlusion of the cervix required cesarean section, in 1 case followed by hysterectomy. Five patients had febrile postpartum periods. Two infants died in the course of delivery.

In patients with simple agglutination of the external orifice digital examination showed a slight depression, and boring at this point with the finger resulted in easy dilatation.

In other patients dilatation proceeded to approximately 5 cm. and examination revealed a poorly effaced cervix which was of the consistency of boiled leather which dilated with the greatest difficulty if at all.

In some patients no dilatation or effacement could be perceived, and the cervix was found to be transformed into a solid undilatable block of tissue.

The cause of these dystocias depends on several factors: defective coagulation, absence of care following coagulation, and the condition of the tissues coagulated.

The object of electrocoagulation was to destroy the mucosa. This was less dangerous when superficial coagulation was performed under good visualization. The skill and experience of the operator were very important when intracervical coagulation was performed, and it must be remembered that repeated superficial coagulations at low intensity may be equally as severe as a single coagulation at high intensity.

Following electrocoagulation it was very necessary to be certain that the external os was soft and pliable and if necessary to dilate the cervix to avoid stenosis.

All cervical tissue does not offer the same resistance, and the effects of coagulation may also vary with the hydration and vascularity of the tissues.

CHAS. W. MUCKLE, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Pheochromocytoma J W S BLACKLOCK J W FERGUSON W S BLACK J SHAFAR and T SYMON-TON. *Brit J Surg* 1947 35 179.

The clinical diagnosis of pheochromocytoma is usually made on the basis of attacks of paroxysmal hypertension. This tumor gives rise to a syndrome that would appear to depend upon the discharge of adrenalin or adrenalinlike substances into the blood stream. Six cases of pheochromocytoma along with numerous microscopic photographs are presented in detail in this article. The authors' cases fall into four fairly well defined clinical groups.

Group 1. The adrenergic sympathetic syndrome illustrated by cases 1 and 2. The symptoms in this group are explained by excessive and intermittent excretion of adrenalin into the blood stream. In cases 1 and 2 it was shown histologically that abundant pro-adrenalin granules were present in the cells of the growth and these granules were observed to pass from the tumor cells into the capillaries. The tumors in both cases were of moderate size, one weighing 86 gm and the other 70 gm, whereas those in the asymptomatic group were very much smaller. The cardiovascular disturbances were most striking. The systolic pressure was raised (160 mm in case 1 and over 300 mm in case 2), the diastolic pressure was correspondingly elevated. There was marked and widespread vasoconstriction, the pulse often being thin and sometimes impalpable. Symptoms referable to the cardiovascular system are sometimes observed including palpitations, precordial pain, pain of an anginal nature, and a feeling of constriction around the chest. Electrocardiographic changes are frequently reported but these show no consistent or distinct pattern. A sinking feeling in the abdomen, numbness in the extremities, choking sensations, dizziness, feelings of anxiety, paresthesias, sensations of heat around the face and sweating have been described in published reports. Headaches are frequent and may be of a "pounding" character. Nausea and vomiting, especially if the seizure succeeds a meal, are frequently reported but diarrhea is less common. During an attack the urinary output may fall and albumin, red blood cells, and casts have occasionally been found. The blood sugar tends to rise with the rise in the blood pressure, thus elevated blood sugar levels and glycosuria are common. There is a wide range in the duration of the paroxysms, for they may last a few minutes or as long as 36 hours. Following the attack, a feeling of weakness and prostration is commonly experienced, especially if the attack has been of long duration. The fall in blood pressure is usually rapid and it sometimes reaches subnormal levels. Between the attacks the patient usually feels well, the blood pressure readings are normal as a rule, but the tendency for persistent

hypertension to develop increases with the duration of the disease.

Group 2. Persistent hypertension. This group may show the clinical features of either benign or malignant hypertension. Cardiac, renal and cerebral manifestations may appear and short of finding a local mass in the region of the adrenal glands there is no distinctive feature that can differentiate this group of cases from those of essential hypertension. In case 3 the tumor was small and no radiological examination would have established the diagnosis clinically. Because the clinical picture of essential hypertension and chronic nephritis may simulate that of pheochromocytoma, the cases of this group may be misdiagnosed.

Group 3. Asymptomatic. This group is usually found at postmortem examination. In cases 4 and 5 of the authors' series there was no indication either from the history or the clinical findings, that the patient had a pheochromocytoma.

Group 4. Malignant. The sixth case reported in this series was an example of a malignant tumor. After the removal of a well encapsulated tumor, there was extension of the process and at the time of death the entire left side of the abdomen and the medial portion of the hypochondrium was filled with tumor tissue.

Pyelography, either ascending or intravenous, may be helpful in establishing the diagnosis in this type of case.

A large tumor will cause a considerable displacement downward of the kidney on the involved side, but even a minor degree of renal ptosis may be significant, especially when it is suspected from the clinical evidence that an adrenal tumor is present. When dealing with smaller tumors or hyperplasia of the adrenal cortex, perrenal insufflation of air has proved to be of great value. A further clarification of the radiological picture can sometimes be achieved by taking intravenous pyelograms about two days after perrenal insufflation.

The preoperative treatment is important. The patient should be kept as quiet as possible before operation and heavy preoperative sedation should be given. The patient suffering from adrenal medullary tumors may be treated on a basis similar to that of patients with toxic goiters. They should be unaware of the time of their operation; otherwise, they are liable to develop a hypertensive attack immediately before it.

The authors made use of a renal extraperitoneal exposure in two of their cases, but they had to resect the last rib in both cases to improve the exposure of the upper part of the tumor.

Manipulation of a pheochromocytoma may cause a sharp rise in the blood pressure, which should be avoided as far as possible. By manipulation of the tumor during operation, large amounts of adrenalin

could quickly be liberated into the blood stream, causing shock thus, before handling the growth it is wise to ligate all vessels coming from the tumor to prevent as much as possible the entrance of adrenalin from the tumor into the general circulation. The upper pole of the kidney can be used as a retractor by pulling the kidney downward and slightly backward which brings the adrenal gland more into view.

As the cortex of the adrenal gland may be involved there may be interference with the secretion of cortical hormone. The therapeutic administration of cortical hormone therefore, should be carried out before and after operation.

Whether to give adrenalin postoperatively is a controversial point. It would appear from histological evidence that the patient is well supplied with adrenalin and further therapeutic administration of adrenalin may intensify the shock due to operation. Sudden withdrawal, however, of large amounts of adrenalin (from the tumor) to which the patient's tissues have been accustomed may cause collapse due to acute adrenalin insufficiency. The authors favor the postoperative medication suggested by Thorn *et al* who used adrenalin, cortical extract, blood transfusion and intravenous glucose saline postoperatively. CONRAD A. KUTNER, M.D.

Renal Salvage. AUSTIN I. DONSON, *J Urol* Balt., 947 52 993.

The author pleads for intelligent conservatism in renal surgery and laments the fact that renal surgery draws heavily upon the skill and knowledge of the surgeon and therefore is often not practiced to the patient's advantage. It is pointed out through clinical illustration that the renal mass which cannot support life is often detrimental both psychologically and physiologically when retained. It is with this in mind that the author carefully distinguishes intelligent conservatism from the mechanical application of a series of plastic renal procedures.

It is noted that one-third of all the nephrectomies done in the city of Richmond, Virginia, from 1930 to 1940 were done because of nephrolithiasis. It follows then that since bilateral nephrolithiasis occurs in from 10 to 20 per cent of all cases this pathological condition can be as dangerous as neoplasm and its surgical therapy must be planned with consideration.

There are reported 5 illustrative cases: 2 of nephrolithiasis and 3 of nephropoikils with pyelectasis. All of the patients were treated surgically without nephrectomy but with excellent results in all except 1 patient who presented a nonfunctioning kidney, with stone, on one side, and a poorly functioning kidney with stone on the opposite side. Stones were removed from both kidneys and a persistent sinus from the nonfunctioning kidney necessitated a secondary nephrectomy with resultant essentially normal urine.

Three instances of nephropoikils with bilateral hydronephrosis were discussed. Conservative renal surgery was exercised with the employment of plastic procedures of the renal pelvis and reimplanta-

tion of the ureter when indicated. Every attempt to preserve renal tissue in these patients was made because of the dictum of Hinman that the ability of renal repair is encouraged by the insufficiency of the opposite kidney and the fact that complete renal destruction occurs more frequently in unilateral hydronephrosis. In this regard the findings of Deming are presented. Deming found that in 37 of 60 patients with unilateral hydronephrosis there was total renal destruction as compared to 3 in 16 patients with bilateral hydronephrosis. The need for conservatism in renal surgery is emphasized by the detailed presentation of the several cases mentioned.

ROBERT LICH, JR., M.D.

Hemangioma of the Kidney. JOHN B. LOWMYER, SAMUEL BARON and HAROLD LEPIERUZE, *J Urol* Balt., 1947 58, 417.

The pathological findings in 2 cases of hemangioma of the kidney as well as the significant findings are reported by the authors. The chief symptom presented by the 2 patients was lumbar pain usually associated with gross hematuria without other urinary symptoms. It was significant that the roentgenological evidence was equivocal. Exploration of the renal area with subsequent nephrectomy was necessitated after the authors failed to establish a diagnosis definitely.

The pathological examination in the authors' first case revealed honeycombing of a small area near the renal pelvis. Microscopic section of the honeycombed area showed a cavernous hemangioma which impinged on the pelvis with a small channel into the pelvis. In the authors' second case the pelvis and a calyx at the upper pole were slightly dilated. A rounded blood cyst projected into the dilated calyx, which on section seemed to communicate with a large blood channel. This appeared to be an aneurysmal dilatation arising from a large vessel. Around the large vessels were clusters of small vessels. Microscopically the tumor consisted of large irregular blood spaces separated by fibrous tissue. Herniating into the blood spaces was a thick walled artery which appeared to have communicated with the large blood space, but an actual site of rupture could not be demonstrated.

These 2 cases are added to the total of 48 already found in the literature. The authors suggest that hemangioma of the kidney be considered in the differential diagnosis of those cases which satisfy the criteria initially enumerated.

PETER L. SCARDINO, M.D.

The Significance of Hematuria in Renal Tuberculosis. (Une signification de l'hématurie dans la tuberculose rénale.) RICH KUTNER, *J urol. med. Pat.*, 945-947 53 997.

In studying the insidious and localized form of renal tuberculosis—the type of kidney tuberculosis that is most liable to escape nephrectomy—the author was struck with the frequency with which the disease was associated with hematuria. Hematuria has a prog-

nostic value in kidney tuberculosis and the author tries to evaluate its precise significance in the disease.

The present study is based on 74 cases of hematuria in renal tuberculosis from the Urological Clinic of Dr Cochlin the observations of Professor Cibert, and on various published reports from the French Urological Society.

Of 74 patients with hemorrhagic tuberculosis, 52 were nephrectomized and the following anatomical findings were observed:

In 7 cases the primary lesions occurred in the cortical and medullary portion without communication with the urinary tract. The lesions consisted of tuberculous granulations or a sclerotic type of tissue. In 17 cases the lesions were ulcerated or caseous communicating with the calices, and consisted of ulcerations involving one or two of the pyramids. In many patients the isolated cavities were the size of a pea, a bean, a cherry or a nut, some were smooth walled or with sinus formation. In 6 cases the lesions were closed and contained clear or mastic fluid. Six of the kidneys were reduced to pyonephrosis.

In the first three classes of cases the association of renal pain and hematuria with ejaculation of blood on cystoscopic examination proved that the source of the bleeding was the kidney. The disappearance of bleeding following nephrectomy confirmed the fact that the original source of the hematuria was the involved kidney. On the contrary, in the patients with pyonephrosis the persistence of the hematuria following nephrectomy led the author to believe that the remaining kidney was the original source of the hematuria.

In 37 of 46 patients (after those with pyonephrosis had been eliminated) examination proved that the lesions were small, limited to one or two small portions of the kidney and that the rest of the kidney was normal.

The results of this anatomical study confirm the belief that bleeding was always from small or minimal lesions of renal tuberculosis. The author concludes that the hematuria was not indicative of the earliest lesion of tuberculosis but rather that it suggested a phase, the initial state of the disease.

A case reported by Vincenti who discovered two granulations in the cortex after hematuria of 8 years duration, is cited. Another case is cited in which a minimal lesion of renal tuberculosis was discovered after years of intermittent hematuria. The author believed it was logical to state that hematuria was a sign of a particular advancement of the lesion different from that usually observed. He did not believe that alarming hematuria always means an extension of the process, for it may remain almost identical on intravenous pyelography after successive episodes of hematuria. The rarity of hematuria in caseous and fibrous forms of the disease can be explained by a study of the anatomicopathological lesion. The vessels showed progressive thrombosis with obliteration of the vascular lumen, the lymphocytic infiltration along with the giant cells being responsible for the vascular lesion. This is the reason that it was

often said that hematuria in renal tuberculosis diminishes in frequency as the disease progresses. In the slowly progressive and hidden lesions the process of fibrosis provided a defense for the surrounding tissue, and also a protective role for the vessels.

Several more cases were cited by the author to emphasize the long interval of hematuria without apparent progression of the disease.

The author found 12 cases of cystitis in the series not including 4 cases of cystitis associated with hydronephrosis; the percentage was very much lower than that reported by Marlon and Cibert.

The lesions were inoperable in 22 of the cases observed. 8 of these were bilateral. In 17 cases the lesions increased in size after a period of 5 years in 7 cases after 10 years and in 5 cases after 8 years.

The absence of extension of the process to the bladder and the long course of the disease with the possibility of healing were considered by Kues to be clinically characteristic of the disease. It was considered possible that a number of hematurias were diagnosed as nephritis, hemorrhagic pyelonephritis or cryptogenic hematurias rather than renal tuberculosis.

Reference is made to a case of hematuria due to renal tuberculosis in which the diagnosis was made in 1941 after episodes of hematuria in 1928, 1931 and 1937. At a time when advocates of early cystomictic nephrectomy are convinced that it is impossible to foresee the evolution of renal tuberculosis, and a second group are advocating nephrectomy based upon the progressive characteristics of the disease, the significance of hematuria warrants a place in the discussion of therapeutic indications.

In resume, the author believes that hematuria can at times be interpreted as an indication of a healing process, and that the cicatrization tendency, the absence of cystitis and the prolonged course of the disease, with a healing tendency favors expectant treatment rather than early nephrectomy.

CONRAD A. KUEHN, M.D.

Papillomatous Disease of the Renal Pelvis. J. B. MACALPINE. *Brit. J. Surg.*, 1947, 35, 113.

The author presented an analysis of 19 cases of papillomatous tumor of the renal pelvis, encountered personally in the span of 29 years and followed up for a long period.

A papilloma may be benign in one part and malignant in another. The tumor may be benign in its early stages and become malignant later. Secondary deposits do not necessarily resemble the primary focus. Whenever papillomatous material is implanted in a wound, whether the neoplasm in the original situation be benign or malignant, the implant will behave as a malignant one. A transference from a primary focus in the bladder or ureter to the pelvis does not occur as an implant but is always transferred with the stream of the urine. A possible exception may take place in hydronephrosis, in which an implant falls into a dilated calyx and takes root.

There appears to be a definite relationship between stone formation and the growth of the renal pelvis.

About 50 per cent of all squamous tumors of the pelvis occur in association with stone. The transitional epithelium of the pelvis in some cases becomes leucoplakic.

A definite diagnosis of this lesion is made either when tumor cells are found in the urine (the bladder being free from disease) or when a papilloma protrudes from the urethral orifice as noted cystoscopically. Pyelograms may show a characteristic filling defect, but often they show the secondary effects, such as pyelectasis.

The correct treatment is ureteronephrectomy. The ureter must be cut flush with the bladder; there is no need for removal of the urethral segment of the bladder. Seedlings within the intramural ureter must be destroyed.

ROBERT TURELL, M.D.

Papillomas of the Renal Pelvis in Dye Workers. J. B. MACALPINE. *Brit. J. Surg.* 1947 35: 137

Since the work of Rehn published in 1895, it has been known that papillomatous disease of the urinary bladder is more prevalent among dye workers than among members of the general population. The author has seen many such vesical neoplasms among dye workers in Manchester, England.

In the present communication the author reports a series of papillomas of the renal pelvis. In one of the patients, who had had antecedent vesical papillomas, the lesion occurred bilaterally. In one patient the renal tumor was discovered 4 years after discovery of the vesical neoplasm, and in the other patient, 5 years after discovery of the vesical neoplasm.

The author states that in one case the tumor was overlooked until it had grown to a large size in spite of periodic cystoscopic examinations. Because of this error it later became routine practice to perform excretory urography at relatively short intervals in these papilloma-forming individuals. A perusal of the literature disclosed reports of 6 other cases of papillomatous disease in the upper urinary tract of dye workers.

ROBERT TURELL, M.D.

Wilms' Tumor. GERRY L. FERRIS, SHERIDAN H. SAEVER, CHARLES E. PAMORY and MICHAEL JACOB. *J. Urol.* Balt., 1947 58: 397

The authors have added 3 cases to the previously 54 reported cases of Wilms' tumor occurring in adults. They give detailed descriptions of the clinical laboratory and pathological findings in the 3 cases.

The occurrence of Wilms' tumor adenomyosarcoma, is apparently not rare in the adult. It has been postulated that when the tumor fails to manifest itself in childhood it is probably the result of arrested development of a myotome which embryologically became included in the development of the kidney. When the tumors fail to develop until adult life, 80 per cent manifest themselves in the fourth, fifth and sixth decades.

The preoperative diagnosis of Wilms' tumor frequently presents a difficult problem. The so-called

diagnostic triad hematuria, pain, and abdominal mass, was infrequently of diagnostic assistance. In the 3 cases reported by the authors the common findings were an unusually large kidney mass associated with a high elevation in temperature but unaccompanied by any noticeable urinary infection. The prognosis is more unfavorable than the known poor prognosis in children.

The diagnosis never having been made preoperatively in an adult, there is no record of preoperative x-ray therapy. Surgery supplemented in an occasional case by deep x-ray therapy has usually been the treatment of choice.

PETER L. SCARDINO, M.D.

Wilms' Tumor. C. M. BURROKS. *J. Urol.* Balt., 1947 58: 418.

Wilms' tumor is a highly malignant neoplasm occurring most frequently prior to the third year but about once in 15,000 hospital admissions. The early diagnosis of this tumor remains somewhat difficult since it fails to give rise to noticeable symptoms in its early stages. The first sign in the child is usually abdominal swelling, but here again one must consider neuroblastoma, hypernephroma, free peritoneal embryoma, and hydronephrosis in the differential diagnosis. The surgeon frequently and perhaps fortunately must resort to exploration to establish the diagnosis. It is of great interest that certain operators have reduced the mortality from 98 per cent during the period from 1914 to 1933 to 40 per cent from 1934 to 1941 by removing the tumor as soon as the diagnosis has been made clinically without preoperative x-ray therapy. The larger tumors are taken out transabdominally. Postoperatively the patients receive x-ray therapy but not because of any known beneficial results. It is known, states the author, that irradiation has never destroyed a metastatic lesion.

The author reports a 3 year cure of a 3 year old female child whose diagnosis was facilitated by a "fortunate" minor accident resulting in pain in the left upper quadrant, vomiting, and a rigid tender abdomen with elevation of the temperature. These symptoms focused the attention of the author on a lesion in the left upper abdomen. The preoperative diagnosis was ruptured intraperitoneal viscus. An emergency exploratory laparotomy was performed with a left subcostal incision. A large retroperitoneal mass was observed but the operator elected not to attempt removal of the mass at this time. Eleven days later utilizing the transperitoneal approach of Ladd, the tumor was removed. Gross inspection revealed that the tumor was small, occupying the lower pole of the kidney. The remainder of the mass was the enlarged kidney due to intracapsular hemorrhage. Microscopically the tumor was a typical Wilms' tumor. Adjacent lymph nodes failed to show tumor microscopically. Postoperatively a full course of deep x-ray therapy was administered beginning a week after discharge. Check-ups at 6 month intervals have failed to reveal metastases. The author is

perhaps justifiably optimistic since it has been authoritatively reported that no patient surviving 2 years has died later of the original Wilms tumor

PETER L. SCARDINO, M.D.

Retropertoneal Tumors of Gerota's Perirenal Adipose Space (Tumor retroperitoneal de la at mosiera adiposa pararenal de Gerota) A. GRANARA COSTA. *Rev argent urol* 1946 15 301

Retropertoneal tumors in the strict sense of the word may be divided according to their location into median lateral or lumbosacral and those of the lesser pelvic cavity. The tumors may be cystic or solid. Approximately 50 per cent of the tumors are malignant. The following are encountered in descending order of frequency: lipomas, fibrolipomas, fibromas, fibromyomas, and myxomas.

The majority of authors when referring to lumbar retroperitoneal tumors have in mind those closely connected with the kidneys and located within Zuckerkandl's fascia. However tumors may develop in Gerota's pararenal fatty tissue.

Retropertoneal tumors are, as a rule, multilobular and have an elastic consistency and a grayish color. Moderate pain and a sensation of heaviness are usually the first symptoms.

Inspection may detect a tumefaction of the involved region when the tumor has attained a certain size. A collateral venous network and less frequently a varicocele may be found. The tumor does not move with respiration. On percussion a zone of dullness may be found in places not covered by the large intestines while a characteristic sonorous sound may be produced in front and below the tumor. Roentgenograms reveal a shadow which may be confluent with that of the liver. The hepatic or splenic flexure is pushed toward the median line and downward. Intravenous pyelography shows that the tumor is adjacent to the kidney but does not involve it. Retrograde pyelography reveals similar conditions. Functional tests of the kidneys show the organs to be normal. Edema of the lower extremities or ascites is rare. If the tumor is benign it is usually of slow evolution.

The differential diagnosis of a tumor of Gerota's space should include kidney tumors, those of the perirenal space or the liver and cysts of the pancreas, mesentery and ovaries. Roentgenograms taken in the lateral direction are very valuable because they may show a shadow between the spine and the kidney. The latter may be displaced toward the midline. The tumor is always situated behind and below the kidney. Perirenal and pararenal tumors usually can be differentiated only at operation.

The treatment is surgical. The twelfth rib may have to be resected. A vertical incision from the axilla to the iliac bone offers good exposure. Large tumors require the transperitoneal approach.

The author removed a tumor of Gerota's space from a man 38 years of age. The weight of the tumor was 1.3 kgm. The histologic diagnosis was fibromyxosarcoma.

JOSEPH K. NARAT, M.D.

Tuberculosis of the Terminal Portion of the Ureter (La tubercolosi del tratto terminale dell uretere) ANTONIO MANFREDI. *Rass internaz dis. inf.* 1947 37 333

The histologic findings in a large number of cases show that tuberculous infection of the ureter occurs essentially by two different routes: the canalicular and the adventitial.

Early localization of the specific infection at the vesical end of the ureter, owing to the fact that this portion is the lowest point at which the urine is normally stopped for a moment before it passes into the bladder, is revealed by careful observation of serial sections. The resultant spasmodic state of the ureteral extremity, although incapable of causing a real and persistent retention, nevertheless produces an overfilling of the canal with urine and interferes with the normal peristaltic waves. The more prolonged contact of the infected urine with the ureteral mucosa and the contemporaneous circulatory disturbances facilitate a slow and uniform ascending dissemination of the bacilli over the entire length of the canal without causing a simultaneous dilatation like that which is observed in chronic ureteropyelitis secondary to retention of urine in the bladder. At the same time the specific infection also invades the ureteral adventitia essentially by the lymphatic route and proceeds downward from the cellular tissue of the renal hilus along the connective tissue strata which surround the ureter. The severity of this infection, therefore, decreases gradually toward the lower end of the ureter. The superimposition of the two processes, which by two different routes (internal canalicular and external adventitial) advance in opposite directions, results in the classical macroscopic aspect of tuberculous ureteritis under the form of a thick, rather hard cylinder, more or less regular in its entire length with restricted lumen or completely abolished lumen.

The author does not deny that other processes may establish the specific infection of the ureter as he realizes there are no organic barriers capable of offering permanent and insurmountable resistance to the tubercle bacillus.

RICHARD KIMMEL, M.D.

Cystectomy and Ureteral Transplantation DAVID A. DREILING and A. HYMAN. *J Urol* Balt. 1947 58 435

The authors report the case of a patient who, at 47 years, was found to have an infiltrating papillomatous vesical tumor involving the left posterior wall and the dome to the right of the midline. Biopsy showed an infiltrating medullary carcinoma with involvement of the lymphatics. A hysterogram demonstrated submucous fibroids and the uterus was found to be slightly enlarged with an irregular surface due to the presence of small myomas. The cervix revealed leucoplakia and severe erosion. The blood was not significantly abnormal and the urine showed many red blood cells.

At exploratory laparotomy the bladder was found to be the seat of an extensive infiltrating tumor in

two distinct masses, and on the anterior surface of the uterus there was a nodule which suggested a carcinomatous implant. There was no distinct involvement of the lymph nodes, nor distant metastases. Immediate resection of the bladder and uterus was indicated and a preliminary ureteroenterostomy was believed to be ill advised because of the imminent threat of neoplastic spread. At the conclusion of the uterine and vesical resection the patient's condition would not permit a ureteroenterostomy and a bilateral ureterocutaneous implantation was accomplished. A histological study of the surgical specimens showed no neoplastic process in the uterus and the vesical lesion had as yet not penetrated the serosa.

Following surgery the ureters retracted from the skin edges and there developed finally a ureterocutaneous vaginal fistula. After a period of drainage of urine from the operative wound and final closure of the retracted initial ureterocutaneous openings, the patient's suprapubic wound closed and the urine drained only through the vagina.

Eighteen weeks following the first operation the patient was again operated upon in the attempt to complete a right ureteroenteric anastomosis. Four weeks later the left ureter was implanted into the bowel. The course following these procedures was benign and the patient was discharged from the hospital.

Five months later the patient was readmitted for biopsy of a mass in the right groin. The biopsy specimen demonstrated adenocarcinoma and the patient died 3 months later or 13 months following the initial surgery.

At autopsy there was found widely disseminated carcinomatous and the urinary tract demonstrated chronic pyelonephritis. It is interesting that the right ureteroenterostomy opening was plugged at least partially by a retained portion of the rubber tube used when the Coffey III operation was performed. The authors consider this a rare but significant complication.

The case reported illustrates quite vividly the fact that ureterocutaneous implantation does not contraindicate future ureteroenterostomy even in the face of serious local complications since even in this instance the cause of death was carcinomatous rather than renal failure due to an unsuccessful implantation.

ROBERT LICH, JR., M.D.

BLADDER, URETHRA, AND PENIS

Vesical Diverticula. HARRY M. SPENCE and SYDNEY S. BAIRD, *J. Urol. Balt.*, 1947, 58, 337

A series of 35 cases of vesical diverticula is analyzed and the principles underlying their clinical management are reviewed. The cases are divided into 3 groups: (1) cases in which no treatment or palliative treatment only was administered; (2) those in which transurethral resection only was performed; and (3) those in which diverticulectomy with surgery of the bladder neck, as indicated, was carried out.

The etiology of vesical diverticula consists of some interference with bladder emptying which results in an outpouching of the mucosa through points of congenital weakness of the bladder musculature. This results in accumulations devoid of muscle fibers, and hence lacking in expulsive power. The size of the orifice may vary from that of a pin point to a diameter of a centimeter or so.

Diverticula are more common in men of middle age or beyond but they occur also in women and occasionally in younger individuals.

The causative obstructive factor in the authors' series was adenomatous hyperplasia of the prostate in 16 patients, median bar or fibrous contracture of the bladder neck in 7, urethral stricture in 6, neurogenic dysfunction in 2, and urethral valves in 2 patients. In 3 cases no cause was demonstrable.

There are no pathognomonic symptoms of vesical diverticulum. The symptoms of bladder neck obstruction plus those of infection which is usually present, constitute the clinical picture. Residual urine, often of a foul character, is a prominent feature. Gross hematuria may occur.

Certain complicating lesions may occur in conjunction with diverticula, such as carcinoma arising in or involving a diverticulum, and calculi in the diverticulum or lying in the bladder in the form of a "dumb-bell" stone. Occasionally the ureteral orifice opens into the diverticulum and complicates the operation.

The treatment of vesical diverticula consists of correction of the bladder neck obstruction and elimination of the retention and concomitant sepsis in the diverticulum proper. In the small, wide-mouthed freely emptying sac, relief of bladder neck obstruction alone may suffice. In the larger types diverticulectomy is necessary sooner or later to restore normal micturition.

The authors believe that diverticulectomy should be performed as a primary procedure whenever retention in the diverticulum is demonstrated irrespective of the size of the sac. To perform a transurethral resection of the prostate initially and watch the outcome of this on the emptying of the diverticulum, results too often in an unduly prolonged convalescence and an unsatisfactory end result.

The authors recommend the technique of diverticulectomy described by Barnes and by Pearson which consists of the removal of the mucosal lining from within the fibrous sac. Once the line of cleavage is established this procedure is carried out with great ease and avoidance of injury to adjacent structures. After opening and exploring the bladder the index finger is inserted through the orifice of the diverticulum and the neck of the latter is severed extravesically. Through an incision in the upper lateral aspect of the diverticulum the plane of cleavage is found and the mucosal lining is removed. The hole in the bladder is then closed from within the denuded diverticulum sac, which is drained and left *in situ*. Cigarette drains are used freely and left in place for at least 1 week. The bladder may be closed about a

suprapubic tube (Pearson) or closed tightly a urethral catheter being used for drainage (Barnes)
FREDERICK A. LLOYD, M.D.

Intraperitoneal Rupture of Bladder CHARLES
DOROVAN TOOL, *J. Urol.*, Balt., 1947 53 431

The author reviews the literature with reference to the infrequency of intraperitoneal rupture of the urinary bladder in the female. Its rarity is emphasized. Reports were found of only 5 cases and of this group 2 patients did not have an associated fracture of the bony pelvis. The apparent reason for the infrequent occurrence of intraperitoneal rupture of the bladder in the female is that the bladder is distinctly an intrapelvic organ unless it is greatly filled with urine or is displaced into the abdomen by a gravid uterus. In the child and in the male, the bladder occupies more of an abdominal position and is covered by peritoneum over a larger surface. Hence intraperitoneal vesical rupture is potentially greater.

The case is reported of a 15 year old girl who was injured in an automobile accident. She was found to have an intraperitoneal rupture of the urinary bladder associated with a greatly displaced pelvic fracture. Due to associated injuries the patient died before any surgical treatment could be under taken.

ROBERT LICE, JR., M.D.

Deslating Gangrene of the Bladder (Gangrena disecante de vejiga) RODOLFO GONZALEZ, *Rev. argent. med.* 1946, 15 171

Gonzalez reports the case of a 50 year old woman who apparently was recovering from the gripe when symptoms referable to her bladder occurred. The condition progressed rapidly. Hematuria and pyuria, as well as vesical tenesmus became severe. A purulent urethral mass appeared which made catheterization imperative. There was a foul urinary odor and the patient's condition showed a general toxic infection. Pneumonia set in and the patient expired. Autopsy revealed gangrene of the bladder with total necrosis of the mucosa, submucosa, and internal muscular coat.

Theories regarding the cause and pathogenesis point to (1) toxicologic factors such as incarceration of the bladder by a gravid uterus and compression by instruments (2) infections such as typhoid fever, meningitis, and gripe (3) physicochemical factors such as instilled hot or caustic solutions, x ray burns, radium, and (4) nerve factors.

The symptomatology and prognosis of the disease are discussed. Drainage is essential in the treatment in order to permit extraction and expulsion of the mucosa and prevent retrograde spread to the kidney.

STEPHEN A. ZIEGLER, M.D.

Disembrioplastic Tumor of the Bladder; Chondrosarcoma (Tumor disembrioplastico de vejiga condrosarcoma) LEON D. AARUZ and ARTURO DI PIETRO, *Rev. argent. med.* 1946 15 137

This is a case report of a 60 year old male who complained of ardor, dysuria, and hematuria for 3

months. Cystoscopic examination revealed a bladder tumor which was removed by radioblasty.

Pathologic studies revealed a tumor with predominant round cell infiltration, some differentiated in aliform cells, and a zone of adult cartilage associated with undifferentiated and embryonal elements. This led to the interpretation that the tumor arose from a mesenchymal embryonic rest.

This type of tumor is rare and two theories are proposed with regard to its origin. One states that the tumor is a metaplasia of the vesical mucosa, whereas the other states that it is an inclusion of a wolffian rest obtained during the formation of the trigone. It has several names: fusiform cellular sarcoma, rhabdomyosarcoma, and leiomyosarcoma.

STEPHEN A. ZIEGLER, M.D.

The Treatment of Bladder Cancer RALPH SHACK
MAN, *Brit. J. Surg.* 1947 35 140

The first instance of cancer of the urinary bladder was recorded in 1593. Operations for bladder neoplasms have been performed since the early part of the seventeenth century. Albarran having ascribed the first recorded operation to Covillard. In 1874 Billroth performed a suprapubic resection of a bladder tumor. Sonnenburg in 1885 performed a partial cystectomy with excision of the local peritoneum. In 1887 Nitze introduced the cystoscope and subsequently elaborated the method of transurethral cystoscopic removal of the tumor with the aid of a snare, followed by cauterization of the raw base. In 1910 Edwin Beer of New York introduced the high frequency current for transurethral diathermy. Barringer in 1922 and Hugh Young in 1923 introduced the therapeutic application of radium.

Total cystectomy was first carried out in 1887 but in 1915 French surgeons advocated this as the method of choice for the treatment of vesical cancer. The first successful transplantation of ureters to the bowel was performed in 1852 but it was not until 1931 when Coffey reported his series of transplantations of the ureters in 35 patients that the method began to gain popularity.

Between the years from 1935 to 1946 the author observed 76 cases of carcinoma of the bladder. Thirty of these patients were considered suitable for radical treatment which consisted of partial or complete cystectomy after ureterocolic anastomosis.

Ureteric transplantation and complete cystectomy was contemplated in 21 patients. Of these 12 died (a mortality of 57 per cent) at some stage of the operative program.

Partial cystectomy which can only be performed if the neoplasm is situated in a favorable site, was performed nine times with no mortality but with a recurrence in 5 patients.

Cutaneous ureterostomy was performed in one patient who died 4 days after operation of peritonitis and uremia.

The late results of treatment were poor and quite similar to those of treatment of gastric cancer.

ROBERT TURELL, M.D.

Urethral Diverticulum. W. GRAHAM KNOX. *J Urol* Balt., 1947 58: 344.

The occurrence of congenital diverticulum of the urethra in the male is rare. In the majority of cases reported in the literature, urethral diverticulum in the male is of the so-called acquired type. These diverticula are most often located in the posterior urethra for here is where the more complex structures of the prostatic portion give rise to a great variety of pathologic processes capable of acting as precursors of a diverticulum. Among these are included the gonococcal infections and complications, straddle injuries, strictures, instrumentation accidents and the lodgment of calculi, either vesical or prostatic in origin. The congenital lesions are confined for the most part to the anterior or pendulous urethra. They occur in the midline and usually arise from the floor of the urethra.

Congenital cysts arising from glandular rests may rupture into the urethra, thus forming diverticula.

Congenital diverticula may be asymptomatic for many years, and their presence may then be discovered because of secondary inflammatory changes resulting from urinary stasis in their lumen. A few have been discovered by chance during endoscopic and x ray examination for an unrelated complaint. Symptoms vary from minimal incontinence to a most distressing frequency and tenesmus, the latter more marked when the lesion is near the sphincter.

Occasionally the diagnosis is difficult to make. It is simplified by the presence of a palpable swelling on the ventral penile shaft but as is usually the case, the external genitalia show no abnormality and the patient is suspected of having merely a urethritis. He is often treated for such, and the opening of the diverticulum which may be quite small, is missed during endoscopy. The diagnosis is made most readily by careful study of a cystourethrogram. The bladder is filled with 200 c.c. of 50 per cent skiodan and views are taken during or right after the patient has been allowed to urinate approximately one-half the amount of the dye.

If allowed to go untreated, congenital diverticula are likely to become the source of an inflammatory process which potentially may lead to suppuration anywhere in the urinary tract. Occasionally calculus formation or fistulous tracts have been reported as arising in them. Since palliative measures such as urethral dilatation, chemotherapy or endoscopic enlargement of the neck of the diverticulum have not proved satisfactory. It would appear that surgical excision of the sac is the procedure of choice. Excellent exposure is obtained with the patient in the lithotomy position and the use of a vertical midline incision. This should be placed posterior to the scrotum to avoid a fistula. Careful plastic repair of the urethra over a fairly large rubber catheter will prevent stricture postoperatively. The complication of wound infection leading to fistula must be considered and adherence to rigid aseptic technique, accurate hemostasis and careful approximation of the wound layers should be stressed.

The author reports the case of a congenital diverticulum of the urethra in an 18 year old male who complained of incontinence of from 10 to 15 c.c. of urine, 15 to 20 minutes after micturition for 3 months prior to admission. Anteroposterior and lateral urethrograms revealed dilatation, to 3 times normal size, of the proximal third of the pendulous urethra.

An attempt was made to plicate the bulbocavernosus muscle over the corpus cavernosum urethrae in the hope that this would permit voluntary emptying of the sac or its obliteration by external pressure, but this was of no avail and 1 month later the diverticulum was resected. An uneventful recovery followed.

FREDERICK A. LYON, M.D.

GENITAL ORGANS

Heterotopic Bone Formation after Prostatectomy
B. S. AXENBOOM. *J Urol* Balt., 1948 59: 50.

Extraskeletal heterotopic bone formation may be classified as of the periosteal, fascial, muscular or combined type. It is a rare lesion and the incidence is greater following intraperitoneal operations than suprapubic operations on the bladder and prostate. This is explained by some writers as being due to the fact that the linea transversa of the rectus muscle is the embryological remnant of a rib and that the linea alba is the downward proliferation of the sternum. A total of 17 cases of heterotopic bone formation following suprapubic operation have been reported previously and the author's case brings this total to 18. A number of theories have been advanced as to the pathogenesis and etiology of this lesion, but none has received widespread support. Trauma seems definitely to be a predisposing factor. It is to be emphasized that this lesion is composed of true cancellous bone in the majority of cases, and is not simply calcification of a soft tissue.

Careful palpation establishes the diagnosis, which must be differentiated from the following conditions: foreign body, osteitis pubis, hematoma of muscle, tumor (either of soft tissue or bone), leiomyosarcoma, faulty healing following fracture of the pubic bone, congenital osteoma of the skin and calcification or ossification in a malignant tumor in the suprapubic area. The treatment is excision of the growth.

Abeabou reports the case of a 54 year old Jewish male who underwent a two stage suprapubic prostatectomy and cystolithotomy, and a subsequent excision of fibrous tissue with a Young's prostatic punch. Convalescence was uneventful, but 6 weeks after operation a 4 cm. knoblike mass was palpated in the upper end of the incision. Roentgenograms supported the diagnosis of heterotopic bone formation. Excision was carried out and the bone was found to be attached to the lower layer of the rectus sheath and extended into the body of the rectus muscle. Microscopic study disclosed the presence of fully developed bony trabeculae within which there were Haversian canal systems. The patient was followed up for 3 years and showed no signs of recurrence.

JOSEPH E. MAURER, M.D.

The Importance of Brucellosis Orchiepididymitis
(Orchiepididymitis brucellosa, su importancia) GUN-
LEO JACAPRERO *Rev argent urol.*, 1940 15 39.

Brucellosis as cause of orchitis and epididymitis has received little attention and practically never enters into the differential diagnosis of urinary or genital lesions. However in the author's country the disease is frequent enough that it must always be ruled out whenever genital tuberculosis postgonorrheal or pyogenic lesions are encountered. This should be the case whenever pasteurization of milk is not done.

Because of the variable symptomatology of brucellosis, clinical diagnosis for the most part must depend upon laboratory findings. The cardinal symptoms are fever, sweats, pains or aches, asthenia, splenomegaly and constipation while the accessory symptoms include anemia, hepatomegaly, orchiditis, epididymitis and adenitis. The various clinical forms of the disease are hemorrhagic pulmonary, pseudotuberculous, hepatic, nervous and urogenital. The last named is by no means an exceptional or rare complication. According to the author genital complications ranged between 4 and 40 per cent, 13 occurring during the febrile period and 3 during convalescence. There were 10 patients with epididymitis, 3 with prostatovesiculitis, 2 with urethritis, 1 with vasculitis and 1 with vasculitis and funiculitis.

STEPHEN A. ZIMAN, M.D.

Perineal Testicle. ARTHUR B. CECIL, J. *Lond. Med.* 1947 58, 384.

The author presents a very succinct account of ectopia of the testicle with a review of the theories of normal and abnormal testicular migration. The patient whose case is reported suffered an ectopic testicle of perineal location which is the one-hundred and fourth case reported in the literature.

The perineal testicle lies freely movable in the perineum on either side of the median raphe and between an imaginary line drawn behind the scrotum and in front of the anus. The scrotum of these patients is asymmetrical, containing both a normal and rudimentary pouch.

The case reported was that of a 25 year old individual who presented a congenitally misplaced perineal testicle. The testicle was approached through a left inguinal incision and the cord isolated. The testicle was then felt in the depths of the perineum, but could not be satisfactorily outlined. A perineal incision was made and after a rather firm gubernaculum was divided the testicle was delivered through the abdominal wound without difficulty. The rudimentary left portion of the scrotum was enlarged through the normal scrotal ring was absent. The testicle, which was found to have an adequate cord, was placed in the newly created scrotal pocket. A scrotal ring was formed and the wounds closed without attachment of the testicle to the scrotum. The resultant repair was entirely satisfactory.

ROBERT LUCE, JR., M.D.

Epididymotesticular Infarct or Apoplexy (Infarto o apopleja epididimotesticular) RODOLFO DE SERRA *CAHARD Rev. As med. argent.*, 1947 61 644.

Epididymotesticular apoplexy is a rare entity. Its etiology is not known, although its mechanism may be due to an arterial infarct, a thrombus, or a capillary apoplexy. The symptoms and diagnosis are so similar to torsion that the surgeon often resorts to expectant treatment with consequent ill results. An immediate castration as was done in the author's case may give more promising results, however they have not as yet been evaluated.

The testicle was 58 mm. in length and 38 mm. in its transverse diameter. The spermatic cord was swollen due to the edema of the connective tissue. The vas deferens appeared to be injected with blood. The microscopic examination showed that both the arterial and venous blood vessels were obliterated by thrombi while an inflammatory infiltration covered all of the vascular layers.

ARTHUR F. CIPOLLA, M.D.

Malignant Epithelial Tumors of the Testis (I tumori epiteliali maligni del testicolo) SALVATORE D'ARRIGO *Gior. med.*, Palermo 1947 4, 116.

The histogenesis of testicular tumors is uncertain. Therefore the classification of these tumors is based on their morphological aspects. Carcinomas of the testis which constitute the greater part of the testicular neoplasms may be divided into two groups, namely seminomas and polymorphous epitheliomas. This classification is justified because both groups have distinct histological aspects and differ from one another clinically and biologically. The term polymorphous epitheliomas comprises a variety of carcinomas such as those with glandular aspect, papilliferous formations, cystic glandular structure, syncytiomas and mesotheliomas. The cells may be cylindrical, cuboid or may resemble endothelium.

ARTHUR F. CIPOLLA, M.D.

MISCELLANEOUS

Excretory Urography by the Intramuscular Route in Admits (Urografia excretoria per la via intramuscolare en el adulto) RICARDO BERNARDI *Rev argent urol.*, 1940 15 379.

The author states that intramuscular urography offers advantages over the intravenous route in cases in which the veins are difficult to find in which repeated injections of hypertonic glucose solution occlude the blood vessels or the sclerosis of veins is caused by the treatment of renal insufficiency. The results compare favorably with those following intravenous injections of opaque medium.

To diminish pain novocain is added. The author mixes 20 c.c. of nitasol with 20 to 30 c.c. of a 1 per cent novocain and normal saline solution to make a total amount of 40 to 50 c.c. Twenty five cubic centimeters of the mixture are injected into the gluteal region and roentgenograms are taken 30, 60 and 90 minutes later. The needles should be

6 to 10 cm. long because shorter ones deposit the solution in the fat tissue instead of the muscles.

It should be remembered that absorption and excretion of the injected solution take place much faster in children than in adults.

The x-ray images are clearer in patients with one kidney whether this be a congenital or acquired condition. The same statement applies to patients with but one functioning kidney.

It is advisable to divide the total amount of solution into two equal parts, each to be injected into the right or left gluteal region, respectively. Occasionally a sensitivity at the site of the injection may remain for 1 or 2 days. The pain may be relieved by warm applications.

JOSEPH K. NARAT, M.D.

High Resection of the Vas Deferens in Genital Tuberculosis (*La deferentectomia alta en las tuberculosis genitales quirúrgicas*) GUILLERMO LACAPRERO *Rev. argent. urol.* 946 5 147

Total resection of the vas is recommended in the cure of tuberculous orchidoepididymitis, the scrotal as well as the inguinal portions should be excised even to the prostatic area, particularly when the lesion involves the internal inguinal region.

The development of the disease is so variable that there is no way to determine which course it may take. Involvement of the prostate and bladder is perhaps more frequent than that of the testicles when the vas contains the primary focus. Secondary spread is intercanalicular via the lymphatics or adjacent structures.

The results of high resection were uniformly good in the hands of the author although it was shown that urinary fistula may occur following high deferentectomy.

STEPHEN A. ZIEKAK, M.D.

Cancer of the Male Breast Secondary to Estrogenic Administration WILLIAM ARAMON and H. WARMAN *Wkly. J. Urol.*, Balt., 948, 59 76.

Lacassagne in 1933 made the first report of the development of breast cancer following the injection of estrogens in male mice of a strain in which the incidence of cancer was high in the female. From the practical standpoint it seems one must accept the conclusion that when there is no estrogenic stimulation there is no development of mammary tumors in male mice.

It is well known that diethylstilbestrol causes increase in thickness of the ducts of the breast tissue, along with increased vascularity and connective tissue proliferation.

Development of cancer of the breast following the use of stilbestrol therapy in the male has not been reported but 3 cases in the female have been reported.

The authors report the case of a 51 year old negro who had terminal metastatic carcinoma of the prostate and was treated with 5,007 mgm. of diethylstilbestrol over a period of 489 days. The breasts were normal at the beginning of treatment, but post mortem examination revealed irregular firm, nodular masses in both breasts. These were adherent to the pectoral fascia. Section revealed diffuse neoplastic, infiltrative growth with involvement of the axillary nodes. General metastases were present from the carcinoma of the prostate. Histopathological examination of the breast tissue showed diffuse, infiltrating growth with myxomatous stroma, and marked hyperplastic changes in the ductal epithelium. Pathological diagnosis was cancer of the breast, and carcinoma of the prostate.

JOSEPH E. MAURER, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES JOINTS MUSCLES TENDONS, ETC.

On Injuries of Bone and Bone Marrow after Intravenous Injections. LUNNART WALLÉN *Acta chir scand* 1947 96 152.

The intraosseous technique has in recent years been used for the therapeutic injection of fluids stimulants, and narcotics when the intravenous route was not readily available. During use of intrataneously injected contrast media for urography pain occurred unless the solution was diluted to be isotonic. This suggested the possibility of tissue damage from hypertonic solutions.

Data on bone complications following intraosseous injections are few. In a series of 750 intraosseous injections reported by Sondergaard (1946) 5 cases (0.67%) of osteomyelitis occurred. Of a group of 23 patients in whom 50 per cent glucose was injected 32 times, 3 patients developed osteomyelitis. The author describes and presents the roentgenograms of the tibia of a child in whom a bone marrow needle was left *in situ* for 5 days for frequent injections of sulfathiazole. Recovery from meningitis followed but a periosteal reaction and irregular density of the bone was still apparent one year later. The intense alkalinity (pH 10.8) of sulfathiazole is suggested as the causative factor of this response.

Care in placing the needle is necessary so that the epiphysis is spared any danger of trauma. The needle should lie free in the marrow cavity so that subperiosteal extravasations and penetration of the opposite cortex are avoided.

Animal investigations correlating the x ray and histological findings at frequent intervals after the injection of various substances emphasize the limited sphere of usefulness of the intraosseous technique. In addition to the requirements for intravenous fluids, intraosseous fluids must approximately conform to the osmotic and acid base conditions of the blood. Chemical toxicity of certain contrast media studied was suspected as a factor contributing to the bone and bone marrow defects observed. Prime among the complications was thrombosis of certain vessels vital to sections of bone. Experimentally some of the degenerative changes in bone and marrow seem to be reversible but others have led to permanent deformity in the affected bone. The use of the intraosseous route is therefore, not without danger and should be used only when venous puncture is impossible. FRANCES E. BRENNER, M.D.

The Neuroendocrine Syndromes in Recklinghausen's Disease (Les syndromes neuro-endocriniens d'ostéolyse diffuse) PIERRE LOMBARD *Rev orthop* Par., 1947 33 312.

The origin of the disturbances which manifest themselves clinically as a process of osteolysis must

be sought much higher in the central nervous system than is generally admitted. The ganglia in the hypothalamic region of the diencephalon send and receive nerve impulses upward through the thalamus to the region of the cerebral cortex and downward toward the hypophysis and the vegetative nervous system to the farthest reaches of the body. However it is to the hypothalamus itself that the attention is particularly drawn by the clinical manifestations accompanying the process of osteolysis. In Recklinghausen's disease itself the osteoporotic process may be accompanied by pain which is neither radicular nor neuritic in character. There is frequently a weakening and wasting of the muscles accompanied by a marked hypotonia and reduced excitability to the electric current but without the reaction of degeneration. These manifestations could conceivably be ascribed to peripheral influences such as disturbances in the metabolism of calcium and phosphorus. However this cannot be affirmed for the cardiovascular signs such as tachycardia and sudden failure of the cardiac muscle, and the poliuria and renal pains resembling the crises of renal calculus.

The occasional attacks of tetany in this condition also point directly to the hypothalamus. The hypothalamus acts directly on the parathyroids by nerve impulses or through the hypophysis (the correlation between the hypophysis and hypothalamus is recognized) and results in the development of an adenoma in one of these glands. Indeed the fact that the adenoma develops in only one of these glands as a rule speaks against a local cause. In tetany the excitability of the facial nerve (Chovatek's sign) and the mental manifestations of irritability and eventually psychoses and mental confusion states speak for involvement at a high level of the brain. This tetany does not necessarily clear up with return of the calcium and phosphorus of the blood to normal. A similar type of tetany is frequently seen in conditions which are admittedly bound up with disturbances of the central nervous system (hypophysis-hypothalamic) such as those following certain thyroidectomies and puerperal eclampsia. In fact the manifestations in tetany are so poorly understood from the content of calcium and phosphorus in the blood that the author has been impelled to incriminate a toxic action of guanidine.

With regard to the general subject of osteomalacia—which becomes an extremely vague one when Recklinghausen's and Paget's diseases are excluded—this does not seem to be one condition etiologically considered but a number of osteomalacias such as those associated with pregnancy when the burden is imposed on the hypophysis and in turn on the hypothalamus, by the developing fetus and the subsequent lactation. Likewise the healing of this condition is brought about by oophorectomy which

can be compared to parathyroidectomy with regard to its effect on the neurovegetative system.

Likewise, there does not appear to be only one rachitis rather there are a number of rachitic conditions, of which the florid form encountered by the pediatrician approaches the adiposogenital syndrome of Froehlich, while the hypotrophic form of rachitis inclines toward Simmonds disease both are known to be of central origin.

The hypothalamohypophyseal origin of a diffuse osteolytic process is seen under a different aspect, but with greatest clarity in Albright's disease. Here the accompanying arrest of bodily growth, the premature closure of the epiphyses, the precocious puberty and the retardation of intellectual development is purely central. Also the patches of abnormal pigmentation are understood when the role of the hypothalamus and the hypophysis in the origin and transport of melanocytes is remembered.

Paget's disease is very similar to that of Recklinghausen's disease in many respects so similar indeed, that in many cases the two cannot be distinguished by means of the microscope and one condition seems at times to develop into the other. Paget's disease is admitted to be on a hypothalamo-hypophyseal basis and assumption of the same origin for Recklinghausen's disease would explain the similarity.

Finally it is pointed out that the disturbances of capillary permeability controlled by the neuroendocrine influence of the higher centers on the reticulo-endothelial system in its regulation of the metabolic exchanges going on in the bone do not always result in simple lysis of bone there are also places where osteoplastic processes predominate and result in osteoid proliferation bordering on tumor genesis and here the influence of the neuroendocrine and nervous systems on the processes of cell division and nuclear multiplications, culminating in the production of parathyroid and hypophyseal adenomas and in the proliferation of fibroplastic areas within the bone itself is related to tumor formation in general.

In this necessarily sketchy discussion of a vast subject the author tries to emphasize the fact that the problem of osteolysis must be reoriented to include systematic studies of the anatomic and functional disturbances of the vegetative ganglia in the diencephalic region of the brain.

JOHN W. BROWN, M.D.

A Case of Disseminated Cystic Fibrous Osteitis (Polyostotic Fibrous Dysplasia)—Albright's Syndrome (Sobre um caso de osteíte fibrosa cística disseminada, displasia fibrosa polioestótica—síndrome d'Albright). A. B. OLIVEIRA CINTRA, HELIO LOURENÇO DE OLIVEIRA, EMILIO MATTAR, YERONICA RAFF and EWALDO MARIO RUSSO. *Arq. dis.*, 947 57

The subject of this study was a girl of 19 who, at the age of 6 and after a cold developed a swelling on the right side of the head including the eyeball. A roentgenogram revealed changes in the frontal bone. She was sent to Germany and during the sea voyage

had a limp of the left extremity. The first diagnosis was Schneller-Christian disease, which was treated by roentgen therapy to the head and the left arm and thigh, in addition to oral and parenteral administration of calcium preparations. At the age of 11 she fell and fractured the upper third of her left arm and femur; at the age of 13½ she sustained another fracture of the upper third of the left femur. Later she had an exploration of the parathyroids because she was suspected of having Recklinghausen's disease but no abnormalities were discovered. Homeopathic treatment was instituted without success, as she had 7 incomplete fractures due to minimal causes during that time. After the age of 16 she felt stronger and by the age of 19 was leading a normal life, but she had a more fracture of the left wrist and arm. Menstruation started at the age of 13 and was normal.

Examination disclosed a prominence of the right frontal bone and supraorbital arch which displaced the eyeball downward outward and forward. Extension of the elbow was limited to about 60 degrees. The left lower extremity was shortened and a bony swelling was felt in the upper third of the left femur. The skin was normal. Roentgen examination revealed extensive lesions of fibrocystic osteodystrophy.

Of the 3 clinical entities which are capable of producing fibrocystic osteodystrophy (hyperparathyroidism, prolonged renal insufficiency and disseminated fibrous osteodystrophy) the third fits the present case. The first two entities were undoubtedly absent. Extensive and disseminated lesions were found in the bones in addition to perfectly normal bony structures. The preservation of the hard laminae of the teeth showed that there was no disease of a general demineralizing character. There were no alterations of the mineral metabolism caused by general disease. True enough there was an increase of phosphatase, but in view of the fact that any bone destruction followed by repair is characterized by increase of phosphatase this finding was of no special significance. There was also a slight decrease of the blood phosphorus which is encountered in hyperparathyroidism, but this isolated finding was of no diagnostic value and has been mentioned in some cases of well established Albright's syndrome. The blood calcium was normal and the urinary calcium was lowered to 53 mgm. per 24 hours, while in hyperparathyroidism calculuria is of fundamental importance for the diagnosis.

Consequently the present case shows a picture which corresponds to the polyostotic fibrous dysplasia of Lichtenstein and Jaffe and to the osseous component of Albright's syndrome in which the other characteristic changes are absent.

RICHARD KIDWELL, M.D.

Osteoid Osteoma. Review of the Literature and Report of 20 Cases. MARY S. SHERMAN. *J. Bone Surg.* 1947 29: 918.

Probably the first description of the pathological picture of osteoid osteoma was made by Bergstrand

who in 1930 reported 2 cases. In 1934 Milch described this lesion. He concluded that he was dealing with a benign osteoblastic tumor forming osteoid tissue and recommended surgical excision. To Jaffe in 1935 is due the credit for establishing this lesion as a distinct entity.

The etiology of these lesions is a subject of much debate. Trauma and infection have been considered etiological factors, however only 3 of the 30 cases reviewed by the author presented a distinct history of trauma. In no case has evidence of either acute or chronic infection been found. Following operation all wounds healed by primary intention. The pathological findings were constant and the author agrees with Jaffe that osteoid osteoma is not of infectious origin, but is best interpreted as a benign tumor.

DANIEL H. LEVINTHAL, M.D.

Eosinophilic Granuloma of Bone (La granulome eosinophile des os) LUCIEN LÉGER, R. DUCROQUET, P. GAUTHIER VILLARS, and S. TCHERKOFF *Presse Méd.* 1948 No 57 648.

A 2 year old boy had tenderness to pressure and spontaneous pain of the left thigh. Roentgen examination disclosed in the upper half of the femur a curious doubly contoured cyst measuring 8 by 3 cm. The cyst was surrounded by a thickened bony cortex. The focus was opened and curetted and a tibial implant was inserted. The symptoms were relieved at once, the cavity in the bone tended to fill in and assumed a polycystic appearance. However 6 months later the pain and limp recurred and the roentgenogram revealed that the tibial graft had been resorbed, the cavity had assumed a multicystic form and had broken through the cortex on the inner surface of the bone. Roentgen therapy was instituted in the dosage of 150 roentgens per session with 3 sessions per week. The total dosage was 3,000 roentgens. The multicystic lesion seemed to be healing at the time of this report and all symptoms had disappeared.

The blood picture was not characteristic and the blood smear exhibited merely an excess of lymphocytes. Histologic examination of the curettings disclosed two cell types. Irregular patches of small deeply staining cells characteristic of young connective tissue were dispersed in a matrix of reticular hyperplasia with large pale cells anastomosing with one another by means of long protoplasmic extensions. The nuclei of these reticular cells were central in location voluminous globular and sometimes doubled and there were frequent mitotic figures. Scattered about the microscopic field were small collections of leucocytes containing numerous eosinophils. The staining qualities and distribution of the tissue components seemed incompatible with a diagnosis of tumor. Foam cells were not identified.

Otani and Ehrlich (*Am J Path.* 1940 16 470) were the first to identify this condition histologically. The authors concede the probability expressed by Jaffe and Lichtenstein (*Am J Path.* 1940 16 595) that eosinophilic granuloma or histiocytic granuloma

as it is sometimes designated in South America, is etiologically related to the Schaller-Christian disease. The condition seems to run a definite course and heal in a few months whether it is treated or not, nevertheless the difficulty in distinguishing it from other conditions, such as tumors, and particularly from Recklinghausen's disease, osseous cysts, the reticuloses of the xanthomatous type, and reticulohistiomonocytosis, renders osseous biopsy imperative.

JOHN W. BRENNAN, M.D.

Madelung's Disease or Hemistrophy of the Internal Part of the Lower Radial Epiphysis (Doença de Madelung, hemistrofia epifisária interna radial inferior) HAROLDO ROSTA PORTELA. *Rev. Brasil Cir.* 1947 16 515.

This case is reported because of the rarity of the lesion and the excellent result obtained by surgical treatment.

Some years ago a girl who is now 16 had experienced pain in the wrists as if they were sprained and had worn leather wristbands until the condition improved. Her attention was then called to the fact that the bone had increased in size. She continued to have slight pain occasionally, which became worse when her wrists were used a great deal. Examination of the wrists disclosed on the posterior aspect of the cubital side a round swelling 2 cm. wide and 1 cm. high. Flexion and extension of the wrists did not change their anterior aspect. All active and passive movements were painful. Seen from the cubital side the wrists presented the aspect of the back of a fork, seen from the radial side there was an anterior curvature of the radius.

Palpation revealed a hard, painless swelling of the ulna which ended in an elevation corresponding to the styloid apophysis. Movements of flexion and extension showed that there was no articular connection between the lower end of the ulna and the carpal bones. The relationship between the radius and the carpal bones appeared to be normal. The two styloid apophyses were on the same level. Roentgen examination showed subluxation of the ulna with external and upward deviation and hemiatrophy of the internal part of the lower radial epiphysis with ascent of the first row of carpal bones, especially the semilunar. The diagnosis was Madelung's disease.

The left wrist was operated upon. A posterolateral incision of 10 cm. was made over the lower third of the forearm down to the bone. The soft tissues were retracted and a cuneiform osteotomy was done on the external aspect of the radius at the level of the epiphysis. The upper and lower portions of the radius were perforated and then approximated with kangaroo tendon. A posterointernal incision was made over the lower third of the ulna and 1.5 cm. of the diaphysis were resected. The upper and lower fragments were perforated and approximated with kangaroo tendon. The ulnar luxation was reduced, the wounds were closed with No. 1 catgut and a right angle plaster cast was applied. Recovery

as uneventful and, one year later the wrist was in excellent condition and all movements were normal.

RICHARD KIECKER, M.D.

Kienboeck Disease—Softening of the Semilunar Bone Following Slow Healing of the Wrist in Industrial Accidents (La enfermedad de Kienboeck—malacia del semilunar—como secuela tardía del cuerpo en los accidentados del trabajo. FRANCISCO FERNÁNDEZ ROSAS. *Prensa méd. argent.* 947 34-9 4

Decalcification with softening and fracture of the wrist bone of the laborer occurs more frequently than is supposed. It is the direct result of numerous minor injuries to the carpal area during work, due to twistings, pullings, contusions, or to associated lesions and fractures in the wrist. The condition at first may escape roentgen detection, but soon pain and muscle spasm set in and progress to the stage where the patient is incapacitated and unable to work. Limitation of active and passive motion is present in addition to swelling and edema of the lower third of the forearm. The disease is important as the articular dynamics of the wrist are disturbed. This leads to serious economic loss and cuts down the laborer's efficiency. Loss of function may run as high as 35 per cent and interposes a delicate medicolegal problem.

Excursion of the lunate bone, molding of the bone or periarterial sympathectomy of the humeral artery is recommended when the recognition of the disease is made early.

The case histories of 8 patients are appended and the medicolegal consideration of each is discussed. The paper is generously illustrated with roentgenograms of each case. STEPHEN A. ZIEGLER, M.D.

Medicolegal Considerations following Injuries of the Wrist (Consideraciones medicolegales de las secuelas de los traumatismos carpicos). FRANCISCO FERNÁNDEZ ROSAS. *Prensa méd. argent.*, 947 34-13 3.

This article considers affections which follow injuries to the wrist and the medicolegal questions which may arise when alterations in the hand or the articular dynamics of that member occur. Some of the pertinent conditions are (1) osteoporosis—Sudeck's syndrome (2) Koehler Monchet disease—scapho id softening (3) Kienboeck's disease—semilunar softening (4) pseudarthrosis of the scapho id and (5) arthritis arthrosis, or post traumatic osteoarthrosis.

These conditions are readily differentiated by anatomic, clinical and roentgenographic studies, but this becomes particularly difficult when the origin of the incapacitating complications is viewed before the law.

Factors to be considered when the injuries are reviewed for medicolegal opinion are classified as anatomic, functional, economic, the bone lesion itself, pain, alteration of the soft tissues, muscular power, articular movements, the economic value of the

hand, and the cause-and-effect relationship to the accident. The capacity must be appraised in percentage values—as 30 per cent disability or 70 per cent usefulness.

Case studies of 9 examples are given.

STEPHEN A. ZIEGLER, M.D.

Backward Displacement of Fifth Lumbar Vertebra in Degenerative Disc Disease. The Significance of the Difference in Anteroposterior Diameters of the Fifth Lumbar and First Sacral Vertebrae. GILBERT H. FLETCHER. *J. Bone Surg.* 1947 39 019.

In the present study based upon 600 roentgenograms of the spine, the author demonstrates that posterior displacement of the fifth lumbar on the first sacral vertebra is a definite pathological occurrence. It is not a separate entity but is a mechanical consequence of degenerative disc disease. The difference in size of the fifth lumbar and first sacral vertebrae has an etiological significance in the production of these degenerative changes.

The universal symptom was backache, most often in the low back limitation of motion and sciatica were commonly associated complaints. All of the roentgenograms were taken with the patient in the recumbent position.

In about 10 per cent of the group or 56 spines, there was posterior displacement (at least 4 millimeters) of the posteroinferior border of the fifth lumbar vertebra in relation to the posterosuperior border of the first sacral vertebra.

From the data presented, the following facts can be stated concerning backward displacement of the fifth lumbar vertebra on the first sacral vertebra:

1. From roentgenograms, the author has confirmed the observation made by Willis from measurements of skeletons, namely that there is often a difference in the diameters of the fifth lumbar and first sacral vertebrae. This difference existed in 87 per cent of the cases with backward displacement, and in practically none of the control group.

2. This difference in diameters was found to account for only about one-half of the apparent backward displacement in 85 per cent of the cases in this series, thus disproving the suggestion that such displacement is only an optical illusion.

3. Backward displacement is usually associated with degenerative changes in the posterior fibers of the annulus fibrosus and a high incidence of advanced degenerative disc disease.

4. From the facts stated in No. 1 and No. 3 above, one sees a correlation between differences in diameters and disc disease.

5. There is no exaggeration of the lumbosacral angle in backward displacement.

6. The lower lumbar and the upper sacral facets are of frontal, or predominantly frontal, type and are in a plane directed downward and backward.

The cause of backward displacement lies in the narrowing of the disc and the amount of displacement will depend upon the obliquity of the facets.

It has been shown that both a high incidence of degenerative changes in the lumbosacral disc and a shortened first sacral vertebra are found in the group with backward displacement while outside of this group there was no difference in size of the fifth lumbar and first sacral vertebrae, and a very low incidence of disc disease, which leads to the inference that there is a correlation between a shortened first sacral vertebra and degenerative changes in the lumbosacral disc.

When such a difference in size exists, the posterior border of the fifth lumbar vertebra overhangs that of the first sacral vertebra so that the posterior fibers of the annulus fibrosus are oblique instead of vertical. This creates an abnormal strain on these fibers and accelerates the processes of byalinization and fissuring which take place during life. This fissuring opens avenues to leakage and dehydration of the nucleus pulposus. The narrowing of the posterior margin results from the degenerative changes in the annulus fibrosus and is followed by thinning of the whole disc.

The differentiation of disc herniation from degenerative disc disease is obviously of great therapeutic importance because in disc disease there is no heretofore material to remove for the purpose of alleviating pressure on the nerve roots. This explains in great part the poor results following surgery. Instead it would seem logical in the presence of disc disease and actual backward displacement to fuse the lumbosacral joint with the lumbosacral junction in hyperflexion in order to reduce the vertebral slipping as much as possible and to improve the width of the intervertebral foramina.

RUDOLPH S. REICH M.D.

Osteochondritis and Coxa Vara in Congenital Subluxation of the Hip, Cured by the Abduction Treatment (Osteochondritis e coxa vara in prelussazioni curate con l'abduzione) GIULIENNO DE LUCCI. *Chir. org. medim.*, 1947 31 193

Hilgenreiner in 1938 again called attention to the fact that in the treatment of subluxation of the hip by abduction osteochondritic changes of the femoral epiphysis developed quite frequently. He was of the opinion that these changes might be due to the method of treatment.

In a statistical study of 777 patients treated at the Istituto Ortopedico Rizzoli, Scaglietti found that 2.18 per cent of the patients treated by the abduction method later developed evidence of osteochondritis of the femoral head.

Selected cases are presented with excellent x-ray films from the collection of the Istituto Rizzoli. It is the author's opinion from this study that osteochondritis of the hip and the coxa vara which develops during the treatment by abduction or years later is not the result of the type of treatment but the result of the primary dysplasia of the bone which is due to altered osteogenesis. This conclusion was first brought forth in 1915 by Delitala. He clearly stated that one cannot consider coxa plana and congenital

dislocation of the hip as parts of the same disease in one there is alteration of form and in the other an alteration in the osteogenesis of the bone.

CARLO SCUDERI M.D.

Large Pseudocyst of the Tibia; the Result of a Chronic Staphylococcus Osteoperiostitis. (Voluminosa pseudocisti ossea della tibia da osteoperiostiti cronica stafilococcica) R. FIORELLINO. *Ann. Ital. Chir.*, 1947 24 303

The author describes a case of large pseudocyst of the tibia which falls into the category first described by Poncet in 1874. This type of infection has a particular predilection for the periosteum which is in juxtaposition to the epiphysis of the long bones. This disease is occasionally seen in children and adolescents, but rarely in adults.

The cavity of the bone is filled with a semigelatinous material which has a very high albumin content.

The author's case was that of a 14-year-old boy who had a large pseudocystic mass in the middle third of the tibia. This mass was the result of a chronic osteitis and periostitis due to the *Staphylococcus aureus*. The patient made an uneventful recovery following incision, evacuation of the cystic mass, partial collapse of the cavity and primary closure of the wound.

A discussion of the various forms of chronic bone infection is presented in the article.

CARLO SCUDERI M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES TENDONS ETC.

The Treatment of Chronic Osteomyelitis by the Use of Spongy Bone Grafting (O tratamento da osteomielite crônica pelo emprego de enxerto de osso esponjoso) FLAVIO PIRES DE CAMARCO. *Rev. Hosp. Clin.*, 1947 2 227

All efforts must be made to achieve rapid and sound healing of chronic osteomyelitis in order to avoid its complications and sequelae. Because of the modern bacteriostatic drugs it is possible to excise thoroughly all fibrous and infected tissues and to follow this by early surgical repair practically without danger to life or limb. Cancellous bone from the ilium is the best material for filling dead spaces created by the intervention. The donor areas of the ilium where cancellous bone is most abundant are immediately below the anterosuperior iliac spine and at the level of the posterosuperior iliac spine.

An incision is made along the anterior border of the iliac crest beginning at the anterosuperior spine and extending for 5 or 6 cm. and the crest is exposed without damage to the muscular insertions. With chisel and mallet the upper part of the bone is raised but not completely detached. The internal and external cortical layers are detached to expose the mass of pure cancellous bone which is removed in small fragments. It is important not to include any cortical bone among the removed fragments because it would imperil the grafting and not to injure the in-

ternal cortex especially in the posterior donor area, because of the vicinity of the sacroiliac joint. When a sufficient amount of cancellous bone has been collected the two cortical layers are approximated, the iliac crest is returned to its original position, and careful suture of the wound is performed. More hematoma forms in the anterior donor area than in the posterior area, but drainage is not necessary a compressive dressing suffices.

The osteomyelitic focus is then carefully excised all eburnated and infected bone being removed the excision must also include the fibrosed and infected soft tissues so as to leave only tissues with adequate circulation in contact with the remaining bone. The defect in the bone is then completely filled with cancellous bone fragments and the wound is closed in one plane. A dry dressing and a plaster cast are applied.

As preoperative and postoperative care is of great importance for the success of the operation the patients were hospitalized 4 days before operation and were given 800,000 units of penicillin daily in addition to the treatment of their general condition. Penicillin was continued for 8 days after the operation.

Three cases are reported. In the first 2 patients, with hematogenous osteomyelitis of the femur and the tibia, the dressing was removed 30 days after operation. Healing was complete, with closure of all fistulas, and a roentgenogram showed perfect assimilation of the graft. The patients were walking casts for 30 days, and were examined 14 months after operation when they were found to be completely cured. In the third patient, with osteomyelitis following open fracture of the tibia, loss of soft tissues had left the bone exposed. Excision of the focus, cancellous bone grafting, and skin grafting were done in one operation and consolidation of the bone graft was complete in 3 months. The patient began to walk without apparatus a month later 11 months after operation he is walking well and has only slight limitation of the movements of the knee.

RICHARD KEMEL, M.D.

Primary Tendon Suture. MARK B. COVERTY and NORMAN E. BECK. *J. Am. M. Ass.* 1947 135 80.

In the period from January 1, 1935 to January 1, 1945, primary suture of the tendons of the hand and wrist was performed at the Mayo Clinic in 43 cases. Tendon lacerations, compound fractures, and avulsions are encountered fairly commonly in the same case at the clinic because of the accidents which occur in the large surrounding rural community.

Forty patients were traced and 28 of them had obtained excellent or good results. The poorest results were obtained when lacerations of the tendons of the flexor muscles occurred in the finger through the fibrous tendinous sheath. Careful adherence to the rules presented gives a higher percentage of good results. Two or more surgical procedures are necessary in many cases before all that can be done for the patient is accomplished.

The poor results have been evaluated carefully. In some cases they were due to infection. In others, to suture of the tendon of the flexor digitorum sublimis as well as the tendon of the flexor digitorum profundus, and in 1 case, to prolonged splinting. In some of the cases in which the result was classed as poor there seemed to be factors which were beyond control.

Arthrodesis of the Elbow. A Preliminary Report of a New Operation. MORRIS GRILMAN. *J. Bone Surg.* 1947 29: 850.

Indications for elbow fusion are relatively few although numerous techniques for the procedure have been described. The operation presented here is not too formidable and has several distinct advantages. Relatively uninvolved bone surfaces are brought into contact, and bone from the operative area is used for a graft which is easily anchored. The radiohumeral joint is preserved and the elbow may be fixed at any desired angle without further operative interference.

Through a medial approach the humerus and ulna adjacent to the joint are exposed anteriorly and the medial epicondyle is chiseled flush with the humeral shaft from above downward. A wire passed through the epicondyle into the humerus controls this wedge which is the graft. It is rotated down to lie on the anterior ulna, and is outlined on the ulnar surface. This wedge of the anterior ulnar cortex is now removed and the freshened humeral fragment fitted into the defect snugly. The angle of fixation is determined and wires or bone pegs through the ulna stabilize the graft in the desired position. The remaining bone chips may be packed in where needed.

The ulnar nerve is transposed anteriorly if it seems to be under tension. Soft tissue closure is made and a plaster shoulder spica cast is applied. When the cast is changed at 8 weeks the protruding wires are removed and the cast is replaced until firm fusion is secured.

One case of tuberculosis of the elbow in a 13 year old boy treated by this technique, is described. Fusion was present at 28 weeks.

FRANCIS E. BRIDGEMAN, M.D.

Transposition of Fingers in Severe Injuries of the Hand. WALTER C. GRAHAM, J. BARRETT BROWN, BRADFORD CAMRON, and DANIEL C. RICHARD. *J. Bone Surg.* 1947 29: 908.

Penetrating wounds of the hand caused by missiles may result in irreparable deformities with scar formation and nerve injuries which occasionally lead to the amputation of one or more fingers. Amputation of the thumb and index finger, two of the most important components of the hand, requires serious consideration regarding restoration of the sacrificed parts. Surgical rehabilitation of or substitution for either of these two digits should be encouraged. Reconstructive procedures of the hand must have two objectives attaining optimum function and achieving an excellent cosmetic result.

As long ago as 1921 Nuzzi Rinaldo and Tonnini performed the operative procedure which will be described. Since 1921 however only an occasional case treated in this manner has appeared in the literature.

The ring finger is substituted for by the fifth finger existing scar tissue with the involved metacarpal down to the base, to leave the blood and nerve supply intact. After osteotomizing the metacarpal of the ring finger the fifth digit is transposed on the fourth metacarpal. While this procedure narrows the hand it improves functional value and enhances the extirpation of the middle finger an osteotomy metacarpal is transposed upon the partially excised third metacarpal bone.

In the absence of a thumb the authors favor excision of the scar removal of the second metacarpal and excision of $\frac{3}{4}$ to 1 inch of the proximal phalanx of the index finger. It being freed from its bed and allowed to retract approximately 2 inches from its original length. The index finger is fixed upon the first metacarpal in moderate ulnar deviation. Immobilization is achieved by Kirschner wire thrust through three adjacent fingers. Occupational therapy is instituted after the healing phases.

SAMUEL L. GOVERNALL, M.D.

Facial Repair for Poliomyelitic Paralysis of the Abdominal Wall in Adults. GEORGE T. WALLACE and WILLIAM J. WEST *J Bone Surg* 1947 39 1031

The importance of abdominal wall defects as related to infantile paralysis was not recognized until Lowman brought the subject to our attention in 1932. Despite pioneer work in the use of fascial grafts the surgical procedure has not been accepted by all clinics as the method of treatment of severely paralyzed patients, possibly because of the surgeon's inability to recognize the advisability of the procedure, or the patient's unwillingness to be operated upon.

At the Army Poliomyelitis Center where only patients with severe paralysis are cared for the problem of rehabilitation has been of extreme concern. Of 66 patients with poliomyelitis, 74 per cent had some degree of abdominal paralysis.

The purpose of this paper is to report 12 abdominal fascial transplantations in 9 cases of residual abdominal paralysis and to show concretely the degree of improvement obtained in each case.

Suitable candidates for surgery preoperative care described in detail. Four patients had had sufficient abdominal paralysis to necessitate two surgical procedures, and 5 patients have needed one surgical procedure. A second operation is to be performed in another case. The second operation is usually performed 3 weeks following the first.

A chart has been devised to show the amount of improvement obtained based on the ability of the

individual to do things which had previously been impossible for him. None of the patients was impaired by the operative procedure. Improvement in balance has been constant in each case. The second physical function in which all patients have shown improvement is walking. A very important improvement observed in all of the patients has been the ability to get on and off a commode 5 patients now being able to accomplish this routine without assistance. Seven patients have noticed improvement in getting in and out of their braces.

These patients must learn to use their new abdominal support. They must learn how to bring the shoulders back and the thoracic cage up in order to put maximum tension on the transplanted fascia, and thus bring forward the anterior portion of the pelvis. This action transmits the needed power from the arms, shoulders, and chest to the lower leg through the fascial straps. It takes a considerable length of time to learn how to do this depending upon the amount of shoulder and chest involvement present.

It is the belief of the authors that if the patient has shown no improvement in the strength of the abdominal muscles for a period of 3 months reconstructive surgery of the type described is indicated. In their opinion a long period of convalescence (before considering surgery) causing atrophy of muscles which were not primarily involved hinders progress. It is an error to consider operation only if all other methods of treatment fail.

It has been noted that after the first few patients in the present series had been operated upon other patients became aware of the postoperative improvement and some have asked if they too might be candidates for a similar procedure.

RUDOLPH S. REICH, M.D.

Fusion of the Hip in Children. The Chandler Method CHARLES N. PEASE, *J Bone Surg* 1947 39 874.

The purpose of fusion of the hip is to replace the involved bone and soft tissue of the hip by a newly transplanted bone from the homolateral femur. The coalescence of the transplanted bone with its inevitable fibroblastic proliferation not only enhances healing but obliterates the pathologic process. Hence the removal of necrotic and tuberculous granulation tissue with subsequent substitution of healthy bone invariably produces a favorable site for new bone formation and connective tissue growth.

The author's study is comprised of 28 children in whom the Chandler operation was performed, and a complete 5 year follow up is presented. Twenty three fusions were done for tuberculosis of the hip 4 for subsiding pyogenic infection and 1 fusion was done for congenital dislocation of the hip. The average age of the children was 7 7 years. No deaths were recorded immediately following the surgery. However three patients died of tuberculous meningitis one year or more after the surgical intervention. The

latter patients suffered from simultaneous tuberculous lesions elsewhere.

The technique of the operation is as follows:

A lateral incision is made, extending from below the crest of the ilium to the junction of the upper and middle thirds of the thigh and splitting the tensor fasciae latae, the vastus lateralis, and the periosteum. The incision is further extended toward the femoral neck and traverses the upper acetabular margin and ilium above the latter.

A generous graft is osteotomized from the trochanter and includes from 3 to 5 inches of the femoral shaft. The graft is placed in Ringer's solution until ready to be used. All articular surfaces of the head of the femur and acetabulum are removed. A recess is made in the ilium for the implantation of the osteoperiosteal graft. Bone chips are obtained from the shaft of the femur to aid in the obliteration of the attenuated hip joint. After the graft has been properly driven under the outer ala of the ilium the incision is closed and a spica cast is applied.

In as much as failure of fusion and subsequent postoperative deformities have been attributable to the powerful adductor muscles of the thigh the author deems it advisable to perform an extraperitoneal section of the obturator nerve (Chandler). Flexion deformity and pseudarthrosis can also be eliminated by this procedure.

SAMUEL L. GOVERNALL, M.D.

Bridge Arthrodesis for Tuberculosis of the Pubis
(Artrodesi ponte per tuberculosi del pube) E.
MILITONE. *Chir. org. modern.* 1947 3 203.

Tuberculosis of the pubis is the rarest of joint tuberculosis. Only a few hundred cases have been reported.

A report of a case in a 38 year old housewife is reported. This patient was treated by the use of an osteoperiosteal transplant removed from the tibia and placed along the superior border of the pubic ramus bilaterally. This was done without opening of the tuberculous area, thus the possibility of contaminating the graft with the tubercle bacillus was avoided. The end result shows an excellent bony bridge between the two sides at the end of 4 post-operative years.

CARLO SCURRI, M.D.

FRACTURES AND DISLOCATIONS

Treatment of Fractures and Pseudarthroses with Marrow Nailing. SVEN KIRSCHNER. *Ann. chir. gyn.* 1947 36 77.

Kirschner's medullary nailing has been used for suitable cases at the Finnish Red Cross Hospitals since the year 1944. The medullary nail has been resorted to, however, only in such cases in which retention performed in some other ways would have involved difficulties. A total of 93 medullary nailings has been performed (47 recent fractures, 34 pseudarthroses, and 12 osteotomies and joint resections). V-shaped medullary nails, made both in Finland and Sweden, have been used and they have

proved satisfactory. On the contrary the chromium plated Kirschner wire which has also been used in ulnar fractures, has turned rusty and has often irritated the bone considerably. For the femoral fractures the average hospitalization was 39 days. The mobility of the joints was satisfactory except in a few cases. In practically all of the femoral fractures the mobility of the knee joint has been at least from 180 to 60 degrees. The range of movement of the other joints has not been restricted. With regard to the tibial fractures, the mobility of the joints has also been unrestricted and this was also true of the range of movement of the other joints.

The various cases of osteotomy in this series are best comparable to recent fractures. The fragments were brought to a desired angle by means of a medullary nail. In all of the completely treated patients a satisfactory result occurred. In 3 cases of knee-joint resection resort was made to medullary nailing. In 2 of them osseous healing took place whereas in 1 there was no consolidation.

The author treated 34 patients with pseudarthroses by means of medullary nailing and in 23 of these there was consolidation while in 9 there was none. The majority of the cases of pseudarthrosis were war injuries and the duration of the condition varied from 6 months to 2½ years. There were 12 femoral pseudarthroses altogether. The site of the pseudarthrosis was exposed in all of the cases, the inter-mediate connective tissue was removed, and the bony ends were sown lightly either straight or obliquely so that partial or entire removal of eburnated bone has taken place. If some of the sclerotic osseous tissue remained a channel was bored through it for the medullary nail. In addition, the bony ends were firmly united in several cases by means of a metal wire.

The poorest results were obtained in nailing pseudarthroses of the ulna and radius. In these cases Kirschner wires were used. These wires were so weak that they could prevent only outward dislocation of the fragments, whereas they were not capable of resisting the tendency of the fragments to angulate.

In summarizing these results, the author advocated resection of the pseudarthrosis and the surfaces of the bony ends by oblique sawing. If the marrow cavities are not open they should be bored. The animal experiments performed by Kuntzsch led him to the conclusion that the medullary nail does not occasion permanent injury to the marrow. However there were no clinical symptoms in these cases. There are only 2 reports on true fat embolism with clinical symptoms in connection with medullary nailing but it was not possible to decide whether the fat embolism occurred as a result of the fracture itself or of the reduction, or whether it was caused by the medullary nail itself. The most suitable cases for nailing are the transverse, short oblique and spiral fractures of the diaphysis. The choice of length and thickness of the nail is determined by the width and location of the narrowest passage of the bone.

In the technique of medullary nailing it is essential that the fracture be well reduced before the nailing as even the slightest dislocation may render impossible the driving of the nail from one medullary cavity into the other. In the reduction of femoral fractures with overriding the author has resorted to wire traction for a few days until the shortening had disappeared. In femoral nailing straight nails are used which are inserted from the upper end of the large trochanter. The patient is placed in lateral position on the extension table with the fractured femur upward. The femur must be bent considerably in the hip joint, so that the top of the trochanter is directed backward against the axis of the body. In thin patients the top is easily palpable. In obese it may be more difficult to find.

In the back edge of the top of the trochanter a sufficiently large hole is made for the insertion of the leader. The position of the leader is checked by roentgenograms to be certain that it is properly located in both the marrow cavities and to determine the length of a suitable medullary nail. The medullary nail is driven along the leader far enough to ensure that it reaches the medullary cavity of the other fragment. The leader is then removed. The nail is subsequently driven in so that only 3 or 3 cm. of it projects from the bone. In the tibia the nail should be inserted 1 cm. above the ankle when the fracture is located in the lower part of the tibia, in order to provide sufficient support. As the nail is inserted from the side it must bend somewhat when inserted. In cases in which the marrow cavity is quite extensive, use has been made of two thinner nails placed side by side instead of one single thick nail which would be too rigid. Care should be taken to prevent the second nail from driving the first nail too far. Occasionally an open reduction must be performed before the nail is inserted. This was the case in a femoral fracture and in several cases of radial and ulnar fractures. The opening of the site of fracture did not cause any complications in these patients.

The nails have remained in the bone until complete osseous healing has taken place usually from 3 to 6 months. If one tries to extract the nail before 3 months have elapsed difficulties may develop, especially when the fracture is in the femur. After 6 months, however, the nail lies so loosely in the marrow cavity that its removal does not require force.

C. FRED GOERING, M.D.

A Method for the Treatment of Fractures of the Expanded Ends of Long Bones. H. K. CHRISTIE.
Austral N Zealand J Surg., 1947 17 29

In the treatment of fractures of the expanded ends of long bones the author uses a "C" clamp with sharp pointed jaws which engage the bone fragments through stab wounds in the overlying soft tissues. The jaws have rounded expanded "shoulders" to prevent their sinking deeply into the bone. He states this clamp is a "logical expansion of Bohler's redresser" and of Steinmann's pins.

The objectives of the device are (1) to reduce and hold reduced the spongy bone fragments around the large joints and (2) to permit immediate movement of the affected joint.

The clamp is applied under roentgenoscopic control. Reduction is carried out with traction (often with temporary use of Kirschner wires and weights). The jaws are inserted through small incisions and the pressure is applied directly to the bone and not to the soft parts. The fragments are thus pressed together and held securely.

Photographs and a table representing 5 cases of fractures about the knee joint are presented. Good function appears to have been obtained in this small series. The author believes that his method has advantages over internal fixation and over methods which require prolonged immobilization of the joints.

NEWTON C. MIZAD, M.D.

Intramedullary Metallic Fixation in the Treatment of Fractures of the Long Bones; Results in 28 Cases (L'infibulamento metallico midollare nelle fratture delle ossa lunghe: contributo di 28 infibulamenti) E. BIALAK *Chirurgia* 1946 1 216

The author gives a résumé of the bibliography of the Kuntscher method of intramedullary metallic fixation of fractures of the long bones. Kuntscher's original presentation was given at the Sixty-fourth German Surgical Congress in 1940.

A description of the operative technique is given in some detail illustrating briefly the method used by the author on various bones.

A report is made in this article of 28 operations done on 24 patients. A number of before and after roentgenograms illustrate the article. The possible dangers and complications of this method are discussed and presented clearly. They are:

- 1 Osteomyelitis, a severe complication
- 2 The use of too large a nail which splits the shaft.
- 3 The use of too small a nail which permits angulation and disalignment.
- 4 Fat embolism.
- 5 Technical difficulties of insertion or removal of the nail.

The author has been using a round nail instead of the V shaped nail of Kuntscher with a smaller diameter and advocates some postoperative immobilization in plaster. Infection occurred in 3 of the cases presented.

CARLO SCUDERI, M.D.

Operative Treatment of the Pseudarthroses of the Neck of the Femur (Traitement opératoire des pseudarthroses du col du fémur) P. LANCE. *Rev orthop. Par.*, 1947 33 363.

If one wishes to discuss the essentials of the problem certain factors must be considered in the selection of one or two operative techniques for the treatment of pseudarthroses of the neck of the femur. Besides the age of the patient these factors are (1) the age of the pseudarthrosis (2) the roentgenologic appearance of the bony fragments especially of the femoral head (3) the degree of

displacement and reduction, (4) and the previous treatment (an attempt at nailing or not)

In pseudarthroses less than 3 months old for which no treatment or inadequate treatment has been instituted the roentgenologic appearance of the head and neck cannot be considered conclusive. If perfect reduction can be accomplished nailing is indicated. If on the other hand reduction is only fairly good or impossible, other procedures must be preferred. If the patient is young and in good condition, an intra-articular arthroplasty or simple refixing of the fragments, followed by nailing may produce consolidation of the lesion. If the patient is 60 years old or more an arthroplasty is the procedure of choice.

In an old pseudarthrosis the pathologic process is arrested. If there is necrosis of the femoral head, or if the vitality of the head is in question, a Whitman or Colonna type of arthroplasty is necessary. A bony shelf is added to the procedure when the neck is short or thin, when the roof of the acetabulum is effaced, or when the stabilization of the neck is questionable. If the femoral head appears normal with only very little displacement of the fragments, intertrochanteric osteotomy is advisable, but if there is atrophy of the head associated with great displacement of the fragments an open osteotomy or arthroplasty are the procedures of choice.

The very old pseudarthrosis in which the neck has completely disappeared can be treated by an intra-articular operation if the patient is in good condition, or by arthrodesis with nailing if the patient is very old. If arthrodesis by nailing does not always produce a complete ankylosis, it, nevertheless, stabilizes the hip and allows the patient to walk. For this reason it deserves to be included in the operative techniques dealing with pseudarthroses.

If the nailing has been accurately executed on a satisfactory reduction and pseudarthrosis occurs after the nailing the pseudarthrosis is then, almost always, the result of partial necrosis of the head. Removal of the nail is imperative and must be followed by osteotomy or arthroplasty. The latter procedure is to be preferred when complete necrosis of the head exists.

Pseudarthrosis may have occurred because of incorrect nailing due to an error in direction or a poor reduction. If the lesion is relatively recent, the whole procedure can be repeated, provided one is certain that there is no anatomical contraindication.

If the fracture is old and pseudarthrosis has been present for several months, one is justified in attempting an arthroplasty or an osteotomy according to the condition of the head and the position of the fragments.

One hundred and three pseudarthroses of the neck of the femur have been surgically treated by the author. Arthroplastic resection was carried out in 63 of them, without operative mortality. Fifty patients were available for follow-up study. Good or excellent results were obtained in 39, or 78 per cent. Nearly all of the patients obtained at least 40

degrees of flexion. Dislocation of the stump of the neck out of the acetabulum occurred twice.

The author stresses the fact that arthroplasty should not be considered a grave procedure which is contraindicated in old patients.

Thirty nine osteotomies have been performed by the author: 30 intertrochanteric, and 19 subtrochanteric, with 6 failures. The length of immobilization in a plaster cast constitutes a serious disadvantage of osteotomy. Limitation of hip motion is a common occurrence. However osteotomy must not be considered as a last resort, reserved only for old and bedridden patients, nor is it the ideal operation solving all the therapeutic problems inherent to pseudarthroses. If correctly executed and well indicated, intertrochanteric osteotomy will usually secure good, and sometimes excellent, functional results.

Pseudarthrosis following nailing of fractures of the neck of the femur is not a rare occurrence. Of a series of 100 cases of pseudarthrosis seen at the Cochin Hospital 16 cases occurred in patients who had undergone hip nailing. Necrosis of the head of the femur was observed 8 times. Resorption of the neck and defective nailing were also factors responsible for the occurrence of the pseudarthrosis.

All pseudarthroses occurring in patients under 70 years of age should be subjected to surgery unless serious organic conditions are present (diabetes, hemiplegia, or cardiac failure). On the other hand, one must be cautious in advising operation in patients over 70 years of age. Extra-articular procedures carrying the minimum risk should be selected.

As a rule, if the pseudarthrosis is compatible with the upright position and associated with a minimum amount of pain, one should refrain from operating.

If the patient cannot walk and the pseudarthrosis is rather recent, reduction and fixation by nailing may be attempted. If reduction is poor or impossible, arthrodesis with a nail is to be preferred to osteotomy which calls for longer immobilization.

The pseudarthroses following pathological fractures as seen in tubercles can be subjected to surgery if the patient is relatively young, in good general condition, and if the arthropathy appears as an isolated manifestation.

The accuracy in reducing and fixing the bony fragments constitutes the best prophylactic treatment against the occurrence of pseudarthrosis.

GERARD GAGNON, M.D.

Fractures of the Femoral Diaphysis in the Infant.
Results of Treatment (*Fractures de la diaphyse fémorale chez l'enfant. Résultats du traitement*).
FRANÇOIS TURRILLON. *Rev. orthop.* Par 1947 33 328.

This study is based on 337 fractures of the femoral diaphysis in the infant, 171 of which were treated by simple orthopedic reduction 87 by traction with the Kirschner wire 33 by traction in flexion (method of Godard) 13 by intramedullary fixation with the

Kuentscher nail, and 30 by open reduction with various procedures. The best results were procured by the flexion pelvi-cruro-jambière method as described by Godard in 1941. By this method a Kirschner wire is passed through the tuberosity or through the condyles and the traction by means of this wire and the rest for the foot are regulated by means of a special attachment to the ordinary fracture table so as to maintain the knee flexed at 135 degrees while the fracture is being reduced and the leg encased in the plaster cast. If need be the reduction is assisted by means of Godard's modification of the Herzog lever. The results obtained by Godard's method are even more striking in that the material included just those cases which would be difficult to treat by other methods. The article is accompanied by several illustrations.

If the cases without initial displacement are omitted, the results with simple closed reduction and plaster of Paris immobilization were good in 34 per cent, indifferent in 35 per cent and bad in 31 per cent and with the Kirschner method good in 45 per cent, indifferent in 35 per cent, and bad in 20 per cent. With the Godard method on the other hand the results were good in 74 per cent, indifferent in 17 per cent and unsatisfactory in only 9 per cent. The Godard method, therefore, has come to be regarded as the method of choice for the cases of displaced fracture which admit of orthopedic reduction.

In the cases treated by open reduction the best results were secured by the temporary cerclage method of Leveuf. In this procedure the bone is encircled by a small wire ligature which is then led through a small metal tube both ends are thus fixed and drawn taut by a mechanism attached to the other end of the tube. While this method can of course be applied only to spiral fractures it has the advantage of cancelling a second operation to remove the fixation material as at the end of the period of fixation the mechanism can simply be loosened and the ligature or ligatures withdrawn. For the transverse fracture the Kuentscher pin is preferred the plaster immobilization is thus avoided and the operation for removal of the intramedullary pin is insignificant. This intramedullary method is even preferred to the simple osteotomies.

JOHN W. BRECKMAN M.D.

Intertrochanteric Fractures of the Femur. A Survey of Treatment in Traction and by Internal Fixation. MATTHEW CLEVELAND, DAVID M. BOWORTH, and FREDERIC R. THOMPSON. *J. Bone Surg.*, 1947 39 1049.

The authors survey 133 consecutive cases of intertrochanteric fractures of the femur and present follow-up studies on 94 per cent of the patients. The series consists of (1) a group of 38 patients treated mainly by traction and (2) a group of 95 patients treated by internal fixation. The final outcome in the cases of all patients treated by internal fixation is known.

The average age of the patients who were treated

by traction was 78 years and of those treated by nail fixation 75 years.

Of the various types of internal fixation the angled one-piece nail and plate described by Jewett in 1941 proved to be most satisfactory. The following changes in its structure were made: the vertical flange on the deep surface, at the junction of the plate and the nail was removed. This flange caused increased comminution of the trochanteric structure of the femur in several instances as the nail was driven home. In several other instances increased comminution was due to attempts at cutting a trough for reception of the nail. A passageway for the Kirschner wire, used as a guide, was eliminated as this weakened the nail or made it more cumbersome. Reinforcement of the junction of the nail with the plate was secured by thickening the plate at this point. The casting of nails with three angles (130 degrees, 140 degrees, and 150 degrees) permitted close coaptation of the plate to the femoral shaft, regardless of the angle of the neck at the time of reduction without the necessity of bending the apparatus. The casting of a nail of each angle in a normal length and in a short length obviated overdrive in severely comminuted fractures. The removal of the streamlined head and its replacement by a ledge behind the head of the nail for application of a hook extractor, facilitated removal when threads in the base of the nail were stripped and a threaded puller could no longer be used. Such a nail can be used successfully in even the severely displaced and comminuted type of para-trochanteric or intertrochanteric fracture with the added advantage of its being of great practical value in the difficult subtrochanteric type of fracture occurring high in the femoral shaft, and in that rare type of fracture in which both the neck and the trochanteric region are involved.

Both a surgical team and a roentgenographic team who are acquainted with the nailing procedure are necessary for the smooth and rapid handling of such cases.

A comparison of the end results in patients treated by internal fixation with those in patients treated by traction reveals the following:

1. With the use of internal fixation the hospital mortality was reduced to 12.6 per cent, as compared to a hospital mortality of 34 per cent after treatment with traction.

2. Severe senile mental deterioration occurred in 11 per cent of the patients following internal fixation as compared with an incidence of 11 per cent in the group treated by traction.

3. The survival rate at the end of 4 years among the patients operated upon was 17 per cent higher than that of the group upon which operation had not been performed.

4. All complications were reduced sharply in those patients who were subjected to internal fixation.

5. Although union of the fracture took place in all survivors, the functional result in those treated by internal fixation was vastly improved.

RUDOLPH S. REICH M.D.

The Indications and the Postoperative Care of Fractures of the Neck of the Femur Treated by the Use of the Putti Screw (Contributo alle indicazioni e al trattamento postoperatorio dell'avvitamento alla Putti delle fratture del collo del femore) GORDO CATALANO *Polidivica sec chir* 947 54-137

The author believes that following the use of the Putti screw, the patient should be kept in bed but early mobilization of the articulations is recommended. No weight bearing should be permitted until evidence of bony union occurs, which takes a minimum of 6 months.

The early use of the leg in bed eliminates the need of physical therapy and also does not require special personnel for the management of these patients.

The author believes that only those patients which belong in group 3 of Pauwel's classification should be subjected to internal fixation by means of a Putti screw. He recommends immediate subtrochanteric osteotomy for all patients that belong in Pauwel's group III.

CARLO SCUDERI, M.D.

Dislocation of the Semilunar Bone with Special Consideration of an Atypical Case (*Luxaciones del semilunar con especial consideración de un caso típico*) CIRILO GONZÁLEZ SÁNCHEZ *Ciruj per locomotor* 1947 4-243.

Six cases of dislocation of the semilunar bone are reported by the author. In one instance an anterior dislocation was combined with rotation of the displaced bone around its longitudinal axis so that the bone assumed the position of supination. The presumptive clinical diagnosis was corroborated by roentgenograms taken in three directions. An open reduction according to Boehler's method was employed with good results.

Of the 6 cases of dislocation of the semilunar bone 3 were combined with a fracture of the scaphoid bone and 2 of them were complicated by a fracture of the apophysis of the styloid process of the radius while in the third case the posterior portion of the lower end of the radius was fractured.

A triangular deformity of the dislocated semilunar bone is a characteristic finding in the roentgenograms.

JOSEPH K. NARAY, M.D.

ORTHOPEDICS IN GENERAL

The Medullary Nail: Presentation of a New Type and Report of a Case. DANA M. STREET, HARVEY H. HARRIS, and BRUCE J. BREWER. *Arch. Surg.* 947 55-433.

The authors believe that the Kuntscher nail supplies fixation of shaft fractures which is analogous to hip fixation by nails. The Kuntscher method originally required open reduction, but was later done under fluoroscopic control the nail being introduced through the femoral trochanter, or into other bones through a hole in the shaft. The double diverging nails of Nasta, introduced through a window in the cortex, were designed to take up the play in those

parts of the medullary canal where there was too much width for the nail to be stable.

The authors describe 4 cases in which an intra medullary nail was used, the nail being different from those used previously in that it was diamond shaped in its cross section.

The advantages of the intramedullary method over previous methods of internal fixation are, in the opinion of these authors as follows: (1) fixation is solid and no cast is necessary; (2) motion of the adjacent joints can be started immediately; (3) no stiffness or atrophy resulting; (4) the patient needs to remain in bed only a short time with early ambulation. The authors feel therefore that this method would be valuable for aged patients; however they do not present any aged patients in their short series. They also believe the method is useful when there is an associated fracture into an adjacent knee or elbow. It is recommended especially for the treatment of comminuted fractures with multiple transverse fracture lines. The fragments are threaded on the nail like beads. If the fracture is near the bone end the nail does not prevent lateral displacement, and is therefore not indicated. This method is contraindicated in compound fractures because of the danger of widely spreading infection.

Callus formation in 3 of the patients was as rapid as that seen after closed reductions. In one case the callus was definitely delayed.

The authors believe that open reduction is safer as it diminishes the risk of fat embolism and this method is easier than inserting the nail at the trochanter and controlling the reduction under the fluoroscope.

The advantages of the diamond shaped nail lie in its strength, and in the fact that it contacts the inner surface of the canal at only two points (as viewed in cross section) and more of the canal is therefore undisturbed. The choice of stainless steel was due to the need for strength and resiliency for fracture or bending of a nail would be a difficult complication to manage. The authors do not recommend this method as a routine means of supplying internal fixation to shaft fractures. NEWTON C. MASON, M.D.

A New Plate for Osteosynthesis. HERBERT SÖLJAND. *Acta chir scand.*, 947 66-178.

Some form of internal fixation is desirable in many types of fracture and most workers find that it is relatively easy to apply and mechanically firm. Abnormal mobility at the fracture site inhibits callus formation while pressure of the fractured surfaces against each other seems to encourage callus formation. The Lane plate may be applied to an anatomically perfectly replaced fracture but on tightening the screws a small diastasis appears. This cannot readily be corrected and the defect persists and may increase as absorption takes place at the fracture site. The rigid fixation prevents approximation of the fracture fragments. The occasional occurrence of delayed union or nonunion when a plate is used seems thus to be on such a physiologic basis.

The author presents a stainless steel plate so per cent lighter than Lane's plate and pliable so that it can be fitted to contour. There is a slot to replace the screw holes, which takes the usual type of screw and permits insertion of the screws at any point desired so that fissures can be avoided and most advantageous fixation secured. The plate affords firm immobilization even after the screws in one fragment are slightly loosened to permit guided gliding of the fracture ends toward each other and maintains constant bony apposition which encourages callus formation. If a screw breaks or goes askant another can be placed beside it without moving the plate.

Röntgenographs of a fracture in a previously osteomyelitic femoral shaft show measurable gliding of the screws in the slot during the course of healing with maintenance of axial position and good callus formation. FRANCIS E. BRENNER, M.D.

Paradoxical Contractions of the Muscles in the Course of Obstetrical Paralysis of the Brachial Plexus. Synergistic Disturbances (Contractions paradoxales des muscles au cours des paralysies obstétricales du plexus brachial. Troubles de la synergie) JACQUES LEVEY, POL LE CORRE, J. LEREVY, and J. LERICQZ. *Rev. orthop.* Par. 1947 33 305

Clinical study and myographic tracings of the action currents in obstetrical paralysis of the brachial plexus have uncovered marked disturbances of muscular synergy. Normally when a muscle contracts under volitional influence its antagonist relaxes and the action current measured on the latter muscle remains unchanged in intensity or even falls below normal. By observing the muscles involved in these obstetrical paralyses during the period of recuperation—the initial stages of this form of paralysis have not as yet been studied—many hitherto unexplained phenomena of muscular action in patients with this condition have been found. The arm cannot, as a rule, be raised above the level of the shoulder, yet passive manipulation of the arm proves that this movement is perfectly free and that the joints are normally mobile.

This phenomenon has previously been dismissed with the explanation that the antagonistic muscle—in this example the deltoid—is too weak to raise the arm any farther. Yet in obstetrical paralysis the muscles are seldom completely paralyzed. When the child is instructed to raise the arm the deltoid begins to contract normally but its antagonists principally the *teres major* and the *latissimus dorsi*, also spring into view, as though they were producing a functional ankylosis of the shoulder joint. This paradoxical contraction of the antagonist can be measured with the myograph for very small movements. Also some contraction can be detected in other muscles, such as the *pectoralis major* and the *subscapularis*.

Identical paradoxical behavior has also been demonstrated with the myograph in the antagonists, the *subscapularis* versus the *infraspinatus*, and in

the *brachialis anterior* and *biceps* versus the *triceps*. Such synergistic dysco-ordination has also been registered by the myograph in the pronator and supinator muscles of the forearm; however the difficulties of myographic study of the forearm have so far prevented the establishment of any definite conclusions. JOHN W. BRENNAN, M.D.

Palliative Operations in Traumatic Palsies of the Upper Limb (Operations palliatives dans les paralysies traumatiques du membre supérieur) M. GUTHRIE SMITH and R. MICHEL D'AUBIONÉ. *Rev. orthop.* Par. 1947 33 390.

A large number of traumatic palsies of the upper limb cannot be readily cured by suture or neuroplasty but in many cases the incapacity can be diminished or even abolished by palliative operations.

There are five main indications for palliative operations in the upper limb: (1) re-establishment of abduction, (2) conservation of the mobility of the elbow, (3) re-establishment of extension of the wrist and fingers in radial palsies (this constitutes the major indication), (4) re-establishment of opposition of the thumb in lesions of the median nerve, and (5) supination, not so much to restore the function but, at least, to place the forearm in a favorable attitude for the use of the hand.

A certain number of principles or rules are essential in effecting tendon transplantation. Before anastomosis is attempted the function of the joints to be moved by the transplanted tendons must be normal or close to it; all deformities should be corrected and retraction of the antagonistic muscles should be abolished. Much reflection must be done in selecting the muscles for transplantation. These muscles must be healthy and strong enough to assure the necessary contraction. It is not necessary for the muscles to have a function similar to that of the paralyzed muscles. Moreover the use of muscles with an opposite function has an advantage: it re-establishes the equilibrium of the powers. However one must not carry this principle too far and jeopardize the stability of the proximal joints.

Certain technical and mechanical precautions must be taken to obtain a good result with a tendon anastomosis: the reactivating muscle must be of similar strength and have a course comparable to that of the tendons that it will move; the bed in which the transplanted tendon is placed must be soft and healthy and allow easy mobilization.

Experience has shown that when one is dealing with palsies of the shoulder and scapular girdle, fixation operations produce the best results. Palsies of the wrist and hand are best treated by restoration and transplantation operations.

At the shoulder arthrodesis, if not the operation of choice is at least the surest solution. In skillful hands transplantation of the *trapezius* muscle for palsies strictly limited to the deltoid muscle has given excellent results.

In cases of isolated palsies of the *serratus magnus*, transplantations have also given fine results. Scap-

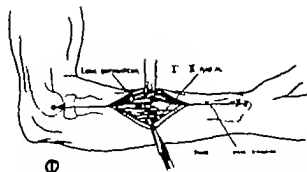


Fig. (Guilleminet and D'Anghel) Transplantation of the pronator teres to the extensor carpi radialis longus and brevis. The pronator teres tendon is drawn by the fine forceps through the holes made in the extensor carpi radialis longus and brevis tendons, to which it will be sutured.

ulopexy is, however, more often preferred, especially if the rhomboids and part of the trapezius muscles are deficient. The loss of the trapezius muscle constitutes an absolute handicap to any restorative surgery.

At the elbow, transplantation of the epitrochlear muscles is a good operation for restoring some degree of active flexion. Transplantation of the pectoralis major on the biceps is the next best. The use of a mechanical device is to be preferred to arthrodesis at the elbow because it will allow a certain degree of motion.

Transplantations to restore active supination produce variable results. One must be satisfied in securing the forearm in a position compatible with function.

The radial palsy can be overcome almost perfectly by tendon transplantations. Extension of the hand is restored by transplanting the pronator teres muscle to the extensor carpi radialis longus and brevis. Extension of the fingers is restored by transferring the flexor carpi ulnaris to the extensors. Abduction of the thumb must be treated separately by transplanting the palmaris brevis or a superficial flexor if the former is absent, to the long abductor and extensor brevis. The palmaris longus must be left in place as a stabilizer of the hand.

If one aims at reactivating the tendons, arthrodesis of the wrist will make all the flexor and extensor tendons of the wrist available for anastomosis.

The function of opposition of the thumb, the loss of which is the most serious and most common sequelae of palsy of the median nerve, can be corrected by fixing the thumb in permanent opposition with an intermetacarpal graft or by arthrodesis. Also a new opponens muscle can be made with one of the superficial flexors or the flexor carpi ulnaris. The new opponens muscle must be reflected at the level of the pisiform bone and fixed to the base of the first phalanx of the thumb.

Less often one will be called upon to correct a palsy of the interossei by using the superficial flexors, or a palsy of the flexors of the fingers and thumb by

transplanting the brachioradialis or flexor carpi ulnaris, or even by tenodesis.

The authors developed a technique of their own to correct the paralyzed extensors of the hand and fingers and have used it in 36 cases during the last 5 years. A 6 cm. incision is made in the middle third of the forearm between the brachioradialis and flexor carpi radialis. The pronator teres tendon is identified and detached from its insertion on the radius. It is obliquely introduced into a hole in each of the extensor carpi radialis tendons to which it is fixed with stainless steel wire. The pronator teres must be fixed under moderate tension the hand being held in slight dorsal extension. A 7 cm. longitudinal incision is made on the anterior surface of the wrist immediately lateral to the flexor carpi ulnaris without crossing of the flexion crest.

The flexor carpi ulnaris tendon is detached from the pisiform bone and liberated for a distance of about 10 cm. The skin is undermined. Through the same incision the palmaris brevis tendon is isolated and detached from its insertion. If the latter is absent, the superficial flexor tendon of the third finger is isolated and divided just above the annular ligament. The distal end is buried in the flexor profundus to prevent the formation of adhesions.

A 3 cm. transverse incision is made just above the flexion crest of the wrist. The skin of the forearm is undermined and the proximal end of the palmaris brevis tendon or the superficial flexor of the middle finger is caught and introduced into the long abductor and extensor brevis tendons of the thumb, which is held in complete abduction and extension. Two stainless steel wire sutures hold the transplanted tendon in place.

A 3 cm. oblique dorsal incision is made 4 finger breadths above the wrist. The extensor tendons of the fingers and the extensor pollicis longus are exposed. The flexor carpi ulnaris tendon is then brought into this incision. The thumb is extended and abducted, the first phalanges of the fingers are held in complete extension with a tenotome, an aperture is made in a direction obliquely downward and outside in the fifth, fourth, third, second and first extensor tendons. A fine hemostat is introduced in a reverse direction through the holes, and the flexor carpi ulnaris tendon is caught and drawn through the holes of all of the tendons. The transplanted tendon is sutured with stainless steel wire to the extensor pollicis longus and to the extensor tendons of the index and third fingers.

After closure of the wounds, the hand and first phalanges of the fingers are kept in forced extension in a plaster cast. The thumb must be kept in complete abduction and extension.

The authors review their results in 36 cases. In 23 transplantations of the pronator teres to the extensor of the radius, the extension of the hand was incomplete in only 1 case. The flexion of the wrist remained limited to an important degree in only 3 cases. The flexion of the fingers was limited in only 4 cases.

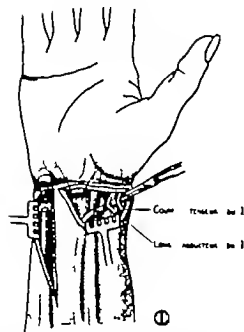


Fig 2 (Gulleminet and D Aubigné) Palmar incision. Dissection and section of the flexor carpi ulnaris tendon. Drawing the palmaris brevis tendon through the long abductor and extensor pollicis tendons of the thumb.

Extension of the thumb was normal in the 10 cases in which transplantation was carried out separately for the extensor pollicis longus (flexor carpi ulnaris) and for the abductor and extensor brevis (palmaris brevis). In the 16 other cases, 5 showed normal extension of the thumb 10 limited extension and 1 definitely insufficient extension.

Following radial palsy it is possible to restore almost normal motion of the hand and fingers by tendon transplantations. The best results are only slightly inferior to those obtained following perfect suture of the nerve while the more inferior results are far superior to those following incomplete regeneration of the nerve. The patient is allowed to use his hand in a period of from 1 to 2 months following surgery.

In the light of these facts, the authors discuss the indications for palliative operations with regard to curative surgery, such as suture or nerve graft. The authors believe that the functional value of the hand following complete regeneration of the radial nerve is superior to that following a successful transplantation.

A good result can be obtained by suture of the radial nerve in from 50 to 80 per cent of the war wounded. Among civilians, the proportion would undoubtedly be higher.

The indications for immediate tendon transplantation are loss of nerve substance of more than 6 cm. and lesions which are a year or more old. The indications for arthrodesis of the wrist are exceptional in simple palsy of the radial nerve, but the procedure is imperative when it is necessary to provide tendons for purposes of transplantation.

GERARD GAGNON, M.D.

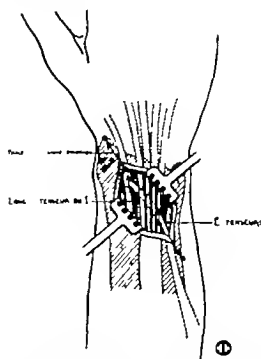


Fig 3 (Gulleminet and D Aubigné) Dorsal incision. Fixation of the flexor carpi ulnaris tendon to the extensor tendons of the fingers and extensor pollicis longus.

Chondromalacia Patellae. JACOB BROMITSKY, J Bone Surg 1947 29 931.

The term chondromalacia patellae applies to a circumscribed degeneration of the articular surface of the patella as evidenced by softening, fibrillation with eventual fissuring and erosion of the cartilage. Although trauma is the primary exciting cause, a predisposed constitution and peculiar mechanism of the knee joint play important roles in the etiology of the lesion.

The earliest detectable lesions are most frequently located on the medial facet of the patella, less frequently in the center and occasionally on the lateral facet. In the most severe cases the entire articular surface may be involved. Wilberg explained that this distribution of the lesions is based on the peculiar anatomy of the patellofemoral joint.

The history is that of chronic knee discomfort of varying degrees of severity. The usual complaints are pain, weakness and a tendency of the knee to buckle. This is noted especially when climbing a hill or on walking up or down stairs. Often there is difficulty in fully extending the knee and momentary locking may be present. There may be effusion into the joint, actual locking may occur when there are loose bodies within the joint frequently the knee aches, especially after sitting for some time in one position, there may be some morning stiffness, crepitation of the patella may be pathognomonic, pain on pressure over the patella is often elicited, there may be fluid within the joint, and atrophy of the thigh muscles. In the early stages of the condition roentgenograms are usually negative.

No patient was operated upon until conservative therapy had failed to give relief. The operations were chondrectomy in which the degenerated cartilage was shaved or the same procedure in which the patellar surface was covered with synovial membrane patelloplasty in which the entire patellar cartilage and subchondral bone were removed with a saw the bony shell then being covered with synovial membrane or complete excision of the patella. The best results were obtained either by chondrectomy or patellectomy.

DANIEL H. LEVINTHAL, M.D.

The Orthopedic Value of the Various Amputations of the Foot (Valor ortopedico de las distintas amputaciones del pie) MARIO OLIVERAS DEVERA *Ciruj. per locomotor* 1946 3: 290.

Various foot amputations are discussed and evaluated in this article. The Lisfrance, Chopart, Ricard, Souligoux, Syme, and Pirogoff methods are specifically singled out and appraised from an anatomic, physiologic, and particularly a prosthetic viewpoint. It is thought that Lisfrance's amputation at the metatarsal articulation gives the best

results according to the criteria advanced, and, when possible it should be employed.

Chopart's amputation is considered a poor operation because the end-results often produce pain in the heel, the anterior scar is extraordinarily sensitive, and interference with the circulation produces ulceration. The Ricard operation gives a very satisfactory result despite its similarity to the Chopart operation. It is more like an astragalectomy and as such produces a better terminal stump than the classic Chopart procedure. Souligoux's technique is more mutilating than Chopart's as it sacrifices the anterior tuberosity of the calcaneus and makes the adaptation of prostheses both difficult and intolerable.

The author has had little experience with the Syme operation, although he believes the operation is good because it permits good prostheses. The Pirogoff operation is considered satisfactory provided the divided part of the calcaneus can be made to unite firmly to the tibia. Supramalleolar operations are best from a prosthetic viewpoint if the lower third of the leg is employed.

STEPHEN A. ZIEGLER, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Carotid Body Tumor in Association with Carotid Sinus Syndrome BARTON McSWAIN and FRANK C. SPENCER. *Surgery* 1947 22 223

A 15 year old male entered Vanderbilt University Hospital, Nashville, Tennessee, complaining of fainting attacks and a lump in the neck. Physical examination showed a firm, nontender mass about 3 cm in diameter just posterior and inferior to the angle of the left mandible. Pressure upon this mass caused pallor, loss of consciousness and a drop in the blood pressure. The mass was removed under intratracheal anesthesia, along with a portion of the cervical sympathetic chain and the superior laryngeal nerve to which the tumor was adherent.

There were no attacks subsequent to surgery. Two and one-half years after excision a mass was felt in the region of the bifurcation of the right common carotid artery. No symptoms could be elicited by pressure. There was no recurrence of the carotid body tumor removed from the right side.

A second patient was found to have a tumor mass similarly located on the left side. She gave a history of many fainting attacks which had occurred 8 years prior to her admission to the hospital. These attacks had become less frequent and had subsequently ceased spontaneously. The mass was excised. Four months after the operation no symptoms had been noted and there was no evidence of recurrence of the tumor mass.

EDITH B. FARNSWORTH, M.D.

The Painful Symptoms of Arterial Elongation (Les symptômes douloureux des dolicho-artères) RENE LERICHE. *Presse méd.*, 1947 57 641

In 1942 the author first described the existence of dilatation and elongation of certain arteries without visible cause. Since then he reported 2 more cases of this condition, and more recently 2 additional instances have been observed by others. Surgeons who operate on the blood vessels have yet to correlate the condition with a definite clinical syndrome. Consequently the diagnosis requires arteriographic or operative confirmation.

An additional case is reported in detail.

A 68 year old male complained of pain in the right iliac fossa of 6 months duration. Appendectomy was performed. At operation an indurated retroperitoneal mass was noted beneath the appendix. Three days after operation the patient began to have persistent severe pain below the right ankle in the upright position, relieved by elevation of the leg and holding it in slight flexion. Examination revealed a strong posterior tibial pulse and a normal oscillometric index in the supine position but the pulse faded and oscillations stopped in the upright position.

The author made a tentative diagnosis of arterial elongation involving the right iliac arteries with



Fig. 1 (Leriche) Retrograde arteriogram by injection of right common femoral artery. Marked tortuosity and elongation are apparent in both common iliac arteries and their branches.

linking in the upright position. In order to confirm the diagnosis, direct aortography was attempted but only the superior mesenteric artery and its branches were visualized. A retrograde arteriogram was then taken through the left femur. Elongation and tortuosity of the left common iliac artery and its branches was demonstrated but the right iliac system did not fill with the opaque medium.

Operation was performed consisting of right lumbar sympathectomy and exploration of the right iliac vessels. The common iliac artery was found to be tortuous and made a bend which brought it under the peritoneum behind the cecum. When postoperative recovery had taken place another retrograde arteriogram was taken through the right femur. The marked tortuosity of both iliac systems was clearly demonstrated (Fig. 1).

In conclusion the author points out that this condition may provide the explanation for certain unexplained right iliac fossa pains in elderly patients. Furthermore, he states that he saw 2 patients in the past with epigastric pain with no basis other than dilatation of the retropancreatic aorta. The etiology and pathogenesis of arterial elongation remain obscure.

THEODORE B. MARRAS, M.D.

Vascular Responses in Man to Ligation of the Inferior Vena Cava. C. THORPE RAY and GEORGE BURCH. *Arch. Int. M.* 1947 80: 587

Observations were made on 12 patients in whom the inferior vena cava had been ligated in the treatment of pelvic thrombophlebitis. Immediately after ligation the pressure in the dorsal pedal veins was markedly elevated in all but 1 patient. There was a gradual decline in venous pressure towards normal but it returned to within the maximum limits of normal in only two instances. There was no relation of venous pressure to the degree of edema or to section of the sympathetic nerves. The pressures in the ante-cubital veins were normal but in 5 of 6 patients there was an elevated pressure in the superficial low abdominal veins. An interesting factor was the absence of abnormal dilatation of the veins of the legs and the feet even in the presence of pronounced venous hypertension.

A quantitative study of the variations in volume of the tips of the fingers and toes was performed plethysmographically. The volume of pulse deflections in the toe tips was reduced immediately after operation to a mean value of 1.3 cubic millimeters per 5 cubic centimeters of part, which increased with time to mean values of 2.7 and 3.0 cubic millimeters. Section of the sympathetic nerves resulted in a greater mean value (5.5 cu. mm.) immediately after operation.

The rate of water loss from the right index finger tip, right second toe tip, right pretibial area, and the volar surface of the right forearm was measured quantitatively in 5 patients. There were no significant disturbances in water loss in a comfortable environment nor in a hot and humid one, the rate of the water loss increasing under the latter conditions.

The plasma protein content was determined in 7 patients at varying intervals after ligation. The protein levels tended to be slightly higher than normal with mean values of 4.8 gm. of albumin, 2.6 gm. of globulin and 7.4 gm. of total protein per hundred cubic centimeters. The range for total protein was 5.3 to 10.6 gm. per 100 cubic centimeters.

Measurements of the pressure in the subcutaneous tissue in the pretibial region were made in 6 patients. The tissue pressures rose after vena cava ligation to mean values of 45 and 50 mm. of water respectively. Tissue pressure tended to vary directly with the venous pressure and inversely with the degree of the edema.

Clinical observations revealed functional capacity of the lower extremities, normal skin temperature, normal color, texture, and nail growth. Two patients manifested no edema either before or after the operation. Edema was present in the remaining 10 patients and varied in severity from mild to extreme, but disappeared within 2 months after operation in all but 3 patients. This disappearance of the edema occurred without a concomitant fall in venous pressure. In only 3 patients did the edema persist for as long as 8 months.

The veins of the feet were small, varicosities were limited to minute veins of the skin. The superficial veins of the abdominal wall and gluteal region and also the long thoracic vein became dilated to form an unusually prominent network. The direction of blood flow was invariably cephalad in these veins of the trunk.

Clinical and physiologic observations failed to reveal any detrimental effect from ligation of the inferior vena cava because of circulatory adjustments which are apparently adequate but not all clearly understood. THORPE R. B. MARRIS, M.D.

The Use of Anticoagulants in the Surgery of Aneurysms and Arteriovenous Fistulas. With Particular Reference to Dicumarol. HARRIS B. SEIDMANN, JR., DAVID I. ARAMSON, and HERBERT H. LAMPERT. *Surgery* 1947 19: 10.

Inasmuch as the reported experimental and clinical data regarding anticoagulant therapy in arterial surgery are limited to the use of heparin alone, the authors believe it is desirable to record their experiences with a group of patients in whom some type of reparative surgery was attempted on a peripheral aneurysm or arteriovenous fistula, and in whom heparin or dicumarol was used either alone or together. The authors discuss the methods and means of control of the therapy employed, the general results, and complications encountered, and they demonstrate that reparative surgery of the peripheral arteries can be safely accomplished with anticoagulants given at the time of operation or before. They admit that the material was insufficiently controlled however to warrant drawing conclusions concerning the relative efficacy of anticoagulants in the prevention of thrombosis following arterial repair.

The clinical material consisted of some type of reparative procedure in 34 of 390 aneurysms and arteriovenous fistulas treated surgically. Among these cases 22 patients were given anticoagulant therapy for a more or less prolonged period of time. An additional patient received a single injection of heparin. The remaining 11 patients underwent simpler surgical procedures and received no anticoagulant therapy, but they did not serve as controls because the hazard of thrombosis was so much less. For the basis in the selection of cases for repair and the clinical results the reader is referred to an article by the senior author which is in press (*Ann. Surg.*). The methods employed for preserving the continuity of the vessel consisted of ligation and transposition of the fistula (13), lateral arteriorrhaphy (5), resection of a segment of the artery with end-to-end suture (10), and vein transplantation (6). Anticoagulant therapy was used infrequently in the first method, generally in the second, and routinely in the other two methods.

Crystalline heparin in aqueous solution was administered intravenously every 4 hours in 50 mgm. doses and continued for 3 days or until a satisfactory effect with dicumarol had been obtained. The first

injection was given at the time of operation. Dicumarol was administered only after an initial prothrombin level had been obtained. In general 300 mgm. were given the first day, 300 mgm. the second and 100 mgm. the third. Thereafter the dosage was determined on the basis of the daily prothrombin time and the drug was continued for about 3 weeks. From 20 to 30 per cent of the normal was chosen as the optimal prothrombin level based upon the Quick curve. The authors claim this value is roughly equivalent to a "clotting index" of 50. The method of Quick for the determination of prothrombin time is given in adequate detail. One member of the staff is given the responsibility for the readings and the dosages.

In 3 patients dicumarol was stopped within 3 to 6 days because of an unusually marked response in one, infection at the site of repair in the second, and because of persistent bleeding from the wound in the third. A fourth patient received 300 mgm. of dicumarol every 4 hours for 5 doses plus 50 mgm. of heparin every 4 hours for the same period. All anticoagulants were stopped when the mistake was discovered and 60 mgm. of synthetic vitamin K were given intravenously. No hemorrhagic difficulties ensued.

Despite the use of anticoagulants 3 patients developed thrombosis following resection of a traumatic aneurysm of the brachial artery with end to end suture in 2 and a vein graft in one. Scarring of the distal portion of the artery or imperfect suture is offered as a possible explanation for these failures. It is emphasized that there was no evidence of propagation of clot in any of the 3 cases.

In no case was any particular difficulty with hemostasis experienced even in the cases in which the prothrombin level had been altered beforehand by heparin or dicumarol. In several cases some later difficulty with bleeding was encountered. Hematomas developed in 3 cases in each of which the wound was reopened within from 2 hours to 30 days after operation and the clot evacuated. Slow persistent oozing from a surgical wound occurred in the fourth case. In one case dicumarol and heparin were stopped on the fourth day because the blood fossa was

great enough to necessitate vitamin K and a whole blood transfusion. The wound was explored and the capillary bleeding found to be stopped with closure of the incision.

In a second series of 256 cases in which the artery was simply ligated and divided no anticoagulants were used. In 2 of these postoperative thrombosis occurred and resulted in a nonfatal partial hemiplegia in the first case and gangrene of the foot necessitating amputation in the second. Infrequent as these disasters are, the authors speculate that they might be avoided by the routine use of anticoagulants.

Dicumarol is a dangerous drug if facilities for daily determinations of the prothrombin level are not available. Without them heparin can be used more safely. It is pointed out that heparin is apparently slightly more effective than dicumarol in preventing thrombosis following arterial trauma. In addition the critical period during which thrombosis is most likely to occur is immediately following operation. Hence the authors suggest that the most effective program may be the administration of heparin immediately preceding operation and for 5 or 6 days thereafter and combined with dicumarol for the following week or two. More extensive clinical trial is needed before a true evaluation of the procedure can be obtained.

The use of anticoagulants is not recommended in surgery of the abdominal, cranial, or thoracic cavities where postoperative bleeding may go unrecognized nor in surgery of the bones and joints for the same reason. While it is the authors' impression that heparin and dicumarol were of benefit in preventing arterial thrombosis, they state that they were not complete safeguards because an adequate and prolonged anticoagulant effect did not prevent thrombosis in two of their patients. The proficiency of the operator, the presence or absence of infection and the extent of local arterial injury are recognized as major factors influencing the outcome of the repair. Helpful as the anticoagulants may be, they will not assure success unless the focal damage is not great, and unless the surgical repair is perfectly performed.

ALLAN D. CALLOW, M.D.

SURGICAL TECHNIQUE

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

Ascorbic Acid, Thiamine, Riboflavin and Nicotinic Acid in Relation to Acute Burns in Man
C. C. LUND, S. M. LEVY, R. W. GREEN, R. W. PARR, and Others. *Arch Surg* 947 55 557

This study is concerned with the alterations in the plasma concentration of ascorbic acid and in the urinary excretion of ascorbic acid, riboflavin and N-methylnicotinamide in patients with burns admitted to the Boston City Hospital, Boston, Massachusetts in 1944 and 1945.

The patients studied were cared for by members of the Burns Assignment of the Surgical Services of the Boston City Hospital. The dietary calculations were made by a research dietitian. All hematologic and routine chemical determinations were made by the methods previously reported from the Thorndike Memorial Laboratory. Determinations of plasma ascorbic acid were made in the Thorndike Memorial Laboratory by the method of Mindlin and Butler. The determinations of vitamin output were made in the Harvard Fatigue Laboratory. Both fasting and hourly excretion rates and the excretions after injections of test doses were determined. Low fasting hourly excretion rates of ascorbic acid, thiamine, riboflavin and N-methylnicotinamide together with low excretions of these substances after the injection of test doses were considered indicative of tissue unsaturation. Vitamin supplements were given orally in the form of ascorbic acid tablets and multi-vitamin capsules. Vitamins were given intravenously in the form of single or multiple vitamin preparations.

The percentage of body surface burned was estimated by the method of Lund and Browder. The depth of the burn was classified according to the method of Coover and Robb-Smith. Dressings in most instances were dry sterile pressure dressings applied usually without anesthesia. The dressings were changed at 1 to 2 week intervals. Grafting was done by the Padgett dermatome technique under cyclopropane anesthesia.

The cases studied are listed in the tables. There were 4 children with minor burns who were in excellent nutritional status on entry to the hospital and none had any complications before or after the burns. The fasting concentrations of plasma and vitamin C and the fasting hourly excretion rates of the various vitamins are listed in a table. In all instances these were within the expected normal range.

There were 3 children with severe burns. In one of these at the twenty-second hour after injury before any vitamin supplements were given, the fasting hourly excretion rates of ascorbic acid, thiamine, riboflavin and N-methylnicotinamide were normal. In 2 adults with minor burns no significant changes

from normal of the vitamins studied were noted. Only patients with some complicating factor such as pre-existing deficiency, low food intake, high fever, alcoholism, or serious infection will show important changes. The courses of such patients are given in detail.

The data presented demonstrate that after severe burns there are considerable alterations in the metabolism of ascorbic acid, thiamine, riboflavin, and nicotinamide. The extent of the abnormalities appears to parallel the extent of the burn. The evidence presented shows a low concentration of ascorbic acid in the plasma either with the patient fasting or after saturation tests and low urinary excretion of these vitamins in severe burns and in patients with complications. These changes were greatest in the early period following injury but continued in some cases far into the chronic stage. In this respect the alteration in vitamin metabolism parallels the changes in nitrogen metabolism which follows burns.

The authors conclude that large doses of ascorbic acid, thiamine, riboflavin, and nicotinamide are needed by severely burned patients and that some supplementation at a lower level is needed for many patients with burns of moderate extent. Similar conclusions had been reached in a study of patients with hemorrhagic shock, traumatic injuries, and infection. It is suggested that from 1 to 5 gm. of ascorbic acid, from 10 to 30 mgm. each of thiamine and riboflavin and from 150 to 250 mgm. of nicotinic acid be given daily to severely burned patients and that the doses may be needed for long periods. The diet should be high in carbohydrate and protein values and include ample quantities of yeast, crude liver extract, and vitamins A and D.

JOHN H. MONARDT, M.D.

The Treatment of Pulmonary Embolus by Stellate Block. WILLIAM E. BAUM and LAWRENCE A. RAFFEL. *Anesthesiology* 947 8 500.

The authors present a more practical aspect of blocking of the stellate ganglion to the syndrome of severe pulmonary embolus. The treatment of pulmonary embolus by stellate block is offered as an adjunct to the present therapy to relieve the acute episodes of this entity. Subsequent therapy of the patient is not in the scope of this paper.

The stellate ganglion is frequently formed by the fusion of the inferior cervical and the first thoracic sympathetic ganglion lying between the transverse process of the seventh cervical vertebra and the neck of the first rib on the medial side of the costocervical artery.

The technique of blocking the stellate ganglion varies, but whatever the approach, anterior or posterior, the surgeon must avoid (1) entering the pleura and causing pneumothorax, (2) injecting the anesthetic solution into a blood vessel, (3) injecting the

solution into the spinal fluid (4) anesthetizing the recurrent laryngeal nerve and (5) anesthetizing the phrenic nerve. Because of the last two complications a stellate block should not be done bilaterally at the same time.

A successful block results in a Horner's syndrome characterized by ptosis, miosis, anhidrosis, injection of the sclera, and increased temperature of the face, neck, arm, and chest wall of the injected side. The authors used the anterolateral approach and after producing a typical Horner's syndrome with 2 to 6 c.c. of a 1 per cent metycaine 1 c.c. of a long acting anesthetic in oil (novestoil) is injected for prolonged effect which persists for 2 to 6 hours and the effect of the block from 2 to 6 days or longer.

The authors report, in detail 2 cases in which stellate block was used with dramatic results.

In the first case, a stellate block was done two episodes of severe pulmonary embolus with dramatic and immediate relief of chest pain. dyspnea orthopnea, cyanosis, and a probable reversal of the shock syndrome. Pulmonary embolus was proven on each occasion by roentgenogram. The third embolus caused death. Necropsy proved the presence of old and recent emboli.

In the second case the patient was not in extremis but suffered severe dyspnea, chest pain and apprehension. A pulmonary embolus was proven by roentgenogram and after opiates had failed except for slight relief stellate block gave immediate and marked relief.

Surgical ligation of the pulmonary artery does not produce chest pain, dyspnea, orthopnea, cyanosis, shock, or death. The authors have listed the possible physiologic patterns in this mechanism.

The fact that pain impulses are transmitted by way of the sympathetic nervous system has been recently accepted by many as a definite entity. It is probable that the pulmonary embolus causes reflex vasospasm of the pulmonary vessels of not only the lung affected but of the vessels of the opposite lung as well. This spasm initiates painful impulses that are mediated by the sympathetic fibers innervating these vessels. These painful impulses plus vasospasm could account for the severe chest pain, dyspnea, orthopnea, chest splinting, and resultant shock seen in severe pulmonary embolic syndrome. In addition to reflex vascular spasm of the pulmonary vessels there may also be a regional sympathetic spasm of the coronary vessels as well regardless of the pulmonary vessels involved right or left. This may explain the bilateral chest pain that may occur and the frequent cardiac irregularities found in many cases.

The blocking of the stellate ganglion interrupts the painful irritation impulses arising from the sympathetic nerves innervating the pulmonary vessels. This apparently breaks up the vicious cycle—pulmonary spasm or coronary vascular spasm phenomena (or both)—by blocking the painful nerve impulses, as stated and permits vasodilation of the pulmonary vessels. The caliber of the bronchioles is ap-

parently unchanged. Repetition of the block is indicated if the cycle recurs.

No dogmatic conclusions are drawn by the authors but the use of stellate block is recommended in patients who have the syndrome of severe pulmonary embolus.

DAVID H. RYAN, M.D.

The Importance of Physiotherapy in Infections of the Hand (Le rôle de la physiothérapie dans les infections de la main) P. BAUWENS, *Bruxelles méd* 1947 27 2275

The infections of the hand have always constituted a difficult problem because of the serious consequences which may follow inadequate or incomplete treatment. The author pays tribute to Kanavel for having formulated the fundamental principles in the treatment of infections of the hand.

Adequate treatment rests on the trio consisting of surgery, chemotherapy and physiotherapy. Each factor is important and indispensable.

Classically a typical infection goes through four stages: inflammation, resolution, repair and functional restoration. These stages are not well delimited, but must, nevertheless, be recognized because the end results largely depend on the rapidity and success of dealing with them. Primarily all efforts are concentrated on arresting the infectious process. The surgeon must decide if chemotherapy is indicated, which agent and what avenue should be used. If surgery is indicated the surgeon must select the time for operation. The rules formulated by Kanavel and his followers should be followed as closely as possible. At the same time short wave treatment should be instituted. At first the whole limb is treated later on the intensity of the treatment is decreased and the treatment is concentrated at the site of infection. The treatment must be supplemented by absolute rest of the tissues directly or indirectly involved. The wrist as well as the hand and fingers must be immobilized in a plaster cast. It is of utmost importance to immobilize the hand in the position of function. The absolute rest reduces to a minimum the tendency of the infection to spread and also the amount of pain. One must, nevertheless, be on the alert for the formation of adhesions between various movable tissues. To prevent such occurrence it is necessary to mobilize the involved joints and tendons as much as pain will permit. It is advantageous to mobilize all the joints of the limb after each diathermy treatment.

After the infection has subsided and become simple inflammation chemotherapy is unnecessary but short wave treatment must be continued to aid in the process of resolution. The extent of immobilization of the affected part is also decreased.

During the stage of repair one must stimulate the proliferation of the tissues by using massive doses of ultraviolet rays. The author recommends a phlogotenic dose. According to Loofbourow and his colleagues, the cells destroyed by the ultraviolet rays produce hormones which have a stimulating effect on the proliferation of the underlying tissues.

To prevent loss of these water soluble hormones, a cod liver oil dressing is applied. Cod liver oil is used because it has an antiseptic effect due to its oxidizing capacity and not because of its vitamin content. When the treatment described is instituted early complications are rare and functional restoration is rapid. Delay in instituting rational treatment diminishes the possibility of obtaining a good functional result. Very often irreversible changes have taken place. The residual disability that may follow is usually the result of stiffness and adhesions. Massage, mobilization, and occupational therapy must sometimes be carried out for several months before maximum restoration of function is achieved.

GERARD GAGNON, M.D.

Tetanus in Kanawha Valley Treated in Charleston, West Virginia Hospitals. S. L. SCHAEFER. *West Virginia M. J.* 947 43 398

In the present article the author reports 33 cases of tetanus which occurred in Kanawha Valley. The patients were treated in Charleston, West Virginia, hospitals. He has based his studies on the 20 patients for whom records were available. Of these 20 7 died a mortality of 35 per cent. Two unusual etiologic agents were otitis media and snake bite. In 1 case tetanus developed 345 days after injury 5 days after open reduction of a compound fracture which had been sustained at the time of the original injury and had failed to unite. Incubation periods for the 20 cases varied from 3 to 345 days, but the length of the incubation did not appear to influence the outcome.

The discussion of pathology symptomatology, and treatment restates sound surgical principles and offers some new therapeutic suggestions. The mechanism of formation of secondary toxic substance resistant to antitoxin, is discussed. The value of immunization with toxoid is affirmed and adequate early wound toilet is emphasized.

Since 3 of the patients in this series had definitely had 1 500 units of antitoxin the author believes that the routine prophylactic dose should be 3 000 units. For initial treatment of the established disease he recommends 80,000 to 100,000 units of antitoxin of which 40 000 to 60,000 units should be given intravenously and the balance intramuscularly.

BENJAMIN F. LOUGHBURY, M.D.

ANESTHESIA

The Technique of Pain Control. BERNARD D. JUDOVICH and WILLIAM B. TER. *Surg. Clin. N. America* 947 7 343.

The authors approach to the technique of somatic pain control hinges largely upon the pattern of tenderness which is associated with the pain, rather than on focusing attention only upon the area of the patient's complaint. Somatic pain is divided into three types (1) local (2) transmitted and (3) reflex.

Classification of the patient's complaint determines the areas to which study and therapy are to be di-

rected. In the local type of pain, the studies and therapy are applied to the area of complaint. In the transmitted type, attention is directed to the spine and its surrounding areas if segmental nerve tenderness is present. In the reflex type of pain, the segments are identified and all skeletal structures receiving nerve supply from this level are carefully examined for a local lesion which produces the radiation.

Of greatest value in controlling pain are the methods which interrupt the afferent pathways. Local infiltration and paravertebral nerve block have proved to be the most effective of all the conservative procedures.

The scalenus anticus syndrome is one of the most common causes of pain in the shoulder girdle and upper extremity. Failure to distinguish between the primary and secondary types, and their causes, and ignoring brachial plexus and sympathetic anesthesia following diagnostic procaine infiltration are the main reasons patients still complain of their original pain after the anterior scalenus muscle has been transected. In the secondary scalenus syndrome, the muscle should not be transected. Many conditions may simulate the anterior scalenus syndrome. None is relieved by a diagnostic infiltration of the muscle.

In any patient with chronic pain and tenderness of the walls of the chest or abdomen a careful examination of the back should be made. If segmental neuralgia is present, the treatment of choice for rapidity of results and duration of relief is paravertebral nerve block.

Lesions causing reflex pain along the course of the sciatic nerve do so because of irritation of somatic structures supplied by branches of the sciatic distribution. Infiltration of the sciatic nerve has been of definite value in the control of pain.

In acute cases of herpes zoster good results are obtained from therapeutic paravertebral nerve block with procaine and ammonium sulfate. In the chronic cases little or no relief of pain was obtained.

The use of intraspinal alcohol is to be reserved for incurable cases and for patients who have severe pain which cannot be alleviated by other forms of therapy. Since 1939, the authors have been using ammonium salt solutions intraspinally and for nerve block. The action of the ammonium ion is that of depression of the C fiber potentials. The ammonium salts are to be used only for pain of this transmitted type which as mentioned, is associated with nerve pattern tenderness.

The intravenous administration of procaine appears to be of definite value in the relief of pain, particularly in cases of trauma or when sympathetic release is desired. The relief of pain takes place by transudation of procaine in areas where capillary permeability is increased in connection with injury inflammation, or edema. Sensitization to the drug is particularly apt to develop in patients with chronic urticaria.

Failures should be investigated from several angles. If the segmental tenderness disappears and the pain

perists it may be caused by (1) a lesion proximal to the point of infiltration, (2) a local lesion which is overlapped by a zone of segmental neuralgia, (3) a visceral lesion which may coexist with the segmental neuralgia and (4) medicolegal complications in which the patient refuses to admit relief of pain.

Among these patients there are undoubtedly some who reflect psychosomatic situations. However applying the term psychosomatic to patients only because no disease can be found is an implication that we have knowledge of all the causes of pain. This is far from the truth.

MARY FRANCES POE, M.D.

Anesthetic Mortality in Intrathoracic Surgery H. LIVINGSTON, G. LIGHT J. CORO and R. ENOKL. *Arch. Surg.* 1947 55 545

The need for intrathoracic operations arises frequently in the management of neoplastic, inflammatory and congenital lesions of the organs within the thorax. These procedures are accompanied by many unusual surgical and anesthetic hazards. Many of the patients are grave risks with manifestations of serious alterations of their cardiorespiratory mechanisms and nutritional state.

In a series of 688 intrathoracic operations the outcome and the relationship of the deaths to the anesthetic management were investigated. Fifty nine or 8.5 per cent of the patients died. The greatest number of deaths occurred 1 to 3 days postoperatively. Death followed a surgical accident in 1 case. Twenty three and seven tenths per cent of the deaths were due to the operation and the disease and the same percentage were due to the disease alone. None of the deaths were due to the anesthetic alone.

Deaths during or following intrathoracic surgery can be minimized by judicious care. Preoperative preparation involves the administration of adequate fluids, plasma and blood transfusions, removal of fluid or secretions from the esophagus, stomach or respiratory tract, and other general measures to improve the condition of the patient.

The maintenance of the anesthetic state is but a small part of the management of anesthesia in intrathoracic procedures. Adequate pulmonary ventilation at all times is of utmost importance. Undue alteration in the cardiorespiratory mechanism must be prevented. The two most important details are the prevention of anoxia and the removal of foreign material from the trachea and bronchi. It is not considered imperative to introduce an endotracheal catheter if a clear airway is evident. Oxygen administration with adequate inhalation pressure is most important. It is necessary to replace promptly all blood lost during the surgical procedure. Routine bronchoscopic aspiration of mucus and blood from the tracheobronchial tree is indicated before the patient leaves the operating room.

Proper postoperative management includes oxygen therapy instituted immediately after operation, the maintenance of a patent airway and prompt aspiration of secretions from the air passages. Continuous suction drainage is applied to a stab wound

drain of the pleural cavity except after pneumonectomy. Adequate water and mineral balance must be maintained. Transfusions of blood and plasma should be repeated when indicated.

MARY FRANCES POE, M.D.

Nupercaine in Dilutions Greater than 1:1500 for Spinal Anesthesia. A. J. FISHER and R. J. WHIT. *ACR. Anesthesiology* 1947 8 584.

The effectiveness of nupercaine as an anesthetic drug has led to the clinical use of this agent in concentrations less than the 1:1500 dilution ordinarily recommended for spinal anesthesia. In order to evaluate the clinical effects of nupercaine in greater dilution, concentrations varying from 1:2000 to 1:10,000 were used in 134 cases of which all but 61 required intra-abdominal operations. The nupercaine solutions were made definitely hypertonic by the use of dextrose. Because sensory anesthesia was usually incomplete, light first plane cyclopropane anesthesia was routinely administered as a supplement.

It appears that the duration of the spinal block is not materially affected by the dilution of nupercaine. Likewise, the degree of relaxation obtained from a given dose of drug did not seem to be influenced by the various dilutions used. There is no evidence that the dilution of nupercaine has any effect upon either the incidence or the severity of circulatory reactions. It appears likely that the size of the dose rather than the dilution is the primary factor to be considered in attempting to minimize circulatory disturbances under nupercaine spinal anesthesia.

It is concluded that there is little or no advantage in using concentrations of nupercaine less than those ordinarily recommended for spinal anesthesia.

MARY FRANCES POE, M.D.

SURGICAL INSTRUMENTS AND APPARATUS

Cotton as a Suture Material in Surgery (Il cotone come materiale di sutura in chirurgia) GIOVANNI D'ENRICO. *Gior. ital. chir.* 1947 3 550.

The author reviews the literature and summarizes the advantages of cotton as advanced by Ginkovski, Meade, Ochsner, Thorek and Foss. He also mentions the reports of D'Inguanni (1945) and Derbyshire (1947) who claim that while cotton is an excellent suture material it is not without risk and has well defined limitations.

The author challenges the popular belief that in sections are less common with the use of cotton. He believes that they are as common as with other non absorbable materials.

In the Naples Surgical Clinic of Torraca, cotton was first used in October 1946. Up to June 15 1947 about 500 operations in which cotton was used for suture were performed. In exceptional cases the material was used alone, usually it was used with catgut but in a few cases it was used with silk or linen.

It is noted that the first surgeons to use cotton adhered to the teachings of Halstead on the use of silk and recommended that not both absorbable and non

absorbable material be used. It is known that these precepts no longer hold with regard to silk as practice has demonstrated that continuous sutures simple ligatures, and the association of silk and catgut sutures do not expose the patient to particular dangers.

In the author's clinic, cotton is used almost always for ligatures and in certain cases for seroserosal and parietal sutures. Number 60 (American nomenclature) is used for ligatures of small vessels and seroserosal sutures. Number 24 is used for larger vessels and the peritonea.

Three complications were encountered. One was wound dehiscence on the fifth day following a gastric resection complicated by postoperative bronchopneumonia. The wound had been closed with cotton. This was successfully repaired with silk and catgut. The second was wound infection in a bilateral Bassini repair of inguinal hernia. Drainage ceased in 3 months after four sutures were expelled. The third occurred in a 43 year old woman who was operated on for the third time when a cholecystectomy was performed. Bronchopneumonia and phlebitis followed. On the tenth day a moderate dehiscence of the wound was noted. For 4 months a large number of sutures were expelled. This was followed by a tumefaction in the epigastric region which was resected and found to be made up of two hard masses of connective tissue one attached to the gall bladder bed and the other attached to the transverse colon.

The first complications were not considered to be due to the cotton especially as they could have occurred with any type of suture material. The third

complication was considered to be an aspecific reaction to a foreign body.

Experiments were performed on 10 rabbits with scrupulous aseptic technique. Two dorsal incisions were made in each animal and the muscles in the paravertebral space were sutured with catgut, silk, linen, and cotton. Numbers 60 and 24 cotton were used and corresponding sizes in the other materials. Four sutures were used in each incision, one of each material and of corresponding size. The catgut used was sterilized with dry iodine and the sizes were 000 and 0. All wounds healed per primam.

The animals were sacrificed successively from the second to the fiftieth day. The sutures together with the adjacent musculoaponeurotic tissue were removed and examined macroscopically and microscopically.

The results are summarized as follows:

All sutures, both absorbable and nonabsorbable, held well (until catgut began to show signs of absorption). The catgut sutures held long enough to assure healing of the tissues.

The decomposition and absorption of catgut caused a larger exudative and leucocytic response. The author did not find cotton to show less response than silk or linen and therefore disagrees with the opinions of Meade and Oschner and Thorak on this subject. From his point of view there is no reason to prefer cotton to silk or linen.

The use of cotton does not eliminate the danger of wound dehiscence or fistula in case of infection. The author finds no particular advantage or disadvantage in using cotton instead of silk or linen.

LESLIE J. FROMMELT, M.D.

vity could not be definitely determined during the period of observation and 4 patients (50 per cent) were found to have healed old coccidioidomycosis with stable pulmonary lesions. The cause of 1 patient's pulmonary infiltration could not be ascertained.

The importance of continued observation, repeated sputum and gastric examinations for acid-fast bacilli, serial chest roentgenograms and weekly determination of the sedimentation rates as aids in determining the activity of pulmonary lesions, is stressed.

FRANK L. HUMET, M.D.

The Differentiation of Mediastinal Tumor and Aneurysm by Angiocardiography MARCY L. SUTEMAN *Am. J. Roentg.* 947 58 584.

Prior to visualization of the heart and great vessels by rapid intravenous injection with contrast media, the differentiation of mediastinal tumor and aneurysm was by inference; however, in view of the rapid advances which have been made in thoracic surgery more precise roentgenographic diagnoses are now required.

The author presents 6 cases to illustrate the scope of angiocardiography in the study of mediastinal masses.

These include (1) dermoid cyst of the anterior mediastinum (2) aneurysm of the descending aorta, (3) poststenotic aneurysmal dilatation in coarctation of the aorta, (4) dilatation of the pulmonary artery, (5) dilated aneurysm of the ascending aorta, and (6) bilateral thymoma.

Occasionally a large aneurysm will not fill with the opaque media due either to the presence of a large clot or a very small neck. Frequently however there are abnormalities, or dilatation of the aorta or pulmonary artery which suggest the diagnosis. Usually tumors do not affect the heart or great vessels except by displacement. Rarely a fibrous tumor may produce a traction aneurysm or malignant infiltration may produce irregular constriction or even occlusion.

R. B. LEWIS, M.D.

Abdominal Venography PEDRO L. FARIAS, *Am. J. Roentg.* 947 53 590

A relatively simple technique is used by the author in an effort to visualize the inferior vena cava and iliac veins. Under local anesthesia, a small incision is made in the middle third of the thigh; the long saphenous vein is exposed and a small trocar is inserted. Usually a tourniquet is placed at the groin level but this is released before the contrast is injected. Thirty cubic centimeters of media are injected rapidly and a 14 by 17 inch film is taken. As rapidly as possible the remainder of the dye (10 c.c.) is injected and the second film is exposed.

Normal venography reveals the femoral, external and common iliac veins and the inferior vena cava; the caliber of the vessel increases as it ascends the lumbar vertebrae, with a compression in the epigastrium. An inflated balloon can be effectively used to visualize the hepatic and renal veins.

Indications for abdominal venography are

- 1 Possible obstruction or thrombosis of the inferior vena cava.
- 2 Abdominal tumors.
- 3 Liver pathology possibly resulting in portal hypertension and necessitating a portal vein and vena cava anastomosis.

MAURICE D. SACCH, M.D.

Abdominal Arteriography; Technique and Diagnostic Application FREDERICK B. WAGNER, JR., ALBION H. PRICE, and PAUL C. SWANSON *Am. J. Roentg.* 947 58 59

Visualization of the abdominal aorta is not an established procedure because of its hazards and complicated technique. The authors describe a simple method which has been used as a diagnostic adjunct with no sequelae in 26 patients.

Preliminary preparation consists of an enema in the morning, no food, and a morphine and atropine hypodermic 45 minutes before the procedure.

A team consisting of a surgeon, two anesthetists, and a roentgenologist is necessary.

The roentgen technical factors are 70-85 kv. 300 ma. 35 second, Potter Bucky diaphragm 30 inch target film distance, fast film, and par speed screens. It is advisable to take a preliminary film to check for proper cleansing, the desired anatomy region, and the correctness of the exposure factors. The technician is ready to take the roentgenogram when the signal is given.

Before the aortic puncture, the patient is anesthetized with a 2 1/2 per cent pentothal sodium solution. The second anesthetist administers oxygen. Emergency drugs such as epinephrine and coramine should be available if necessary.

A number 18 gauge malleable needle is used for the aortic puncture. To this are attached 2 feet of rubber tubing with a Luer Lok adapter and 10 c.c. syringe. Extra openings along the side of the needle near the tip will decrease resistance to the injection. With strict surgical technique on the x-ray table 10 c.c. of an 80 per cent sodium iodide solution are injected into the aorta. For an aortic puncture at the level of the twelfth dorsal vertebra, the skin is pierced below the left twelfth rib 4 fingers breadth from the spinous process. The needle is directed anteriorly medially and cephalically toward the body of T12 until bone is encountered. It is then withdrawn a cm. and inserted laterally into the aorta. A sharp snapping sensation is felt when the aorta is entered. The renal artery is best visualized by entering the aorta at L-1 and the iliac vessels at L-2.

Before dye is injected, a preliminary precaution of alternate saline injection and blood withdrawal should be tried several times to assure the operator that the needle is in correct position. Ten cubic centimeters of sodium iodide are injected at the rate of 2 c.c. per second. As the final 1 or 2 c.c. of dye are leaving the needle, the signal is given for the roentgen exposure and the needle is then withdrawn.

The patient recovers from the anesthesia in from 5 to 10 minutes. A liter of 5 per cent glucose is ad-

ministered via the intravenous anesthesia needle which is left in place. No case of iodism has been observed.

This procedure is a valuable diagnostic aid in aortic aneurysms, occlusions, peripheral vascular disease, abdominal tumors, hypertension, and hydrocephalus associated with aberrant vessels. However, the examination should be done only by trained personnel and only after the usual studies have failed to yield enough information for a diagnosis.

MAURICE D. SACHS, M.D.

Röntgen Visualization of the Inferior Vena Cava
BERNARD J. O'LOUGHLIN *Am J Roentg* 1947 58 617

The author presents a method for the contrast roentgen visualization of the inferior vena cava which he believes is simple and safe. The method consists of injecting 35 per cent diodrast into the femoral vein and visualizing the external and common iliac veins and the inferior vena cava on films. No serious or ill effects have occurred in any of the 50 patients injected.

FRANK L. HUSSEY, M.D.

Röntgen Findings in Duodenal and Primary Pancreatic Malignant Lesions. J. R. KUNK and G. J. CULVER. *Am J Roentg* 1947 58 435

The authors discuss the roentgenologic aspects of primary duodenal and pancreatic malignant lesions and present 3 cases to illustrate the lesions. Carcinoma of the duodenum is a rare condition, however, it must be borne in mind when considering lesions of the upper gastrointestinal tract.

In the suprapapillary portion of the duodenum the lesion is usually a constricting one narrowing the lumen, and infiltrating and eroding the mucosa. This type of lesion is usually a scirrhous adenocarcinoma. In this type the most common symptom is pain and the stool is frequently positive for blood. The roentgenoscopic finding after the ingestion of a barium meal is a very small protuberance jutting into the lumen with the mucosa destroyed over the area. There is no associated spasm or tenderness such as one finds in inflammatory lesions. Spot roentgenograms are of value to demonstrate the mucosal detail in this and other lesions of the duodenum.

In the penampullary portion, the lesion may be a constricting adenocarcinoma as previously described producing the same signs and symptoms. In addition this lesion if arising near the papilla of Vater may very early infiltrate the papilla and cause a blockage of the flow of bile into the duodenum. Jaundice and light colored stools may occur.

Papillary adenocarcinoma in this region causes constriction after the mucosa and submucosa become infiltrated. The stool is often positive for occult blood. Carcinomas in this region produce the same roentgenographic findings as described, however, the filling defect may be greater. This lesion cannot be differentiated from a lesion of the ampulla of Vater.

Carcinoma of the infrapapillary portion of the duodenum is the least common of these lesions. This lesion usually occurs near the duodenojejunal junction and is most often an infiltrating constricting adenocarcinoma. It is usually scirrhous in type and metastasizes early. Symptoms appear later and are usually pain and occult blood in the stools. The earliest roentgenological finding is narrowing of the lumen. Destruction and distortion of the mucosal folds and a loss of the distensibility and pliability of the wall also occurs.

Carcinoma of the ampulla of Vater obstructs the common bile duct early. Jaundice and light colored stools are early symptoms. Occult blood in the stool and secondary anemia occur. There is a tendency toward early metastasis. Annular constriction may be produced by lymphatic extension. Following ingestion of a barium meal a small filling defect protruding from the posteromedial or medial wall of the second portion of the duodenum is seen. The mucosa may be eroded or distorted.

Invasion of the duodenal wall by carcinoma of the head of the pancreas may resemble carcinoma of the duodenum. Painless and progressive jaundice are the cardinal symptoms. If the lesion erodes the duodenal wall or duodenal mucosa the stools may be positive for occult blood. An increase in the duodenal movement does not occur in early lesions. A primary carcinoma of the bile duct with duodenal extension may resemble a primary carcinoma of the duodenum. It produces signs of common duct obstruction early. The other symptoms are distended gall bladder pain and abdominal distress. If the lesion erodes the duodenum at the site where the duct passes under the first portion of the duodenum the duodenal mucosa may become eroded with roentgenographic findings similar to those of a primary carcinoma of the duodenum.

Aberrant pancreatic tissue tumors in the wall of the duodenum may produce stenosing lesions without any change in the mucosal pattern. They are differentiated from the primary carcinoma lesions by this factor. The importance of correct diagnosis is to bring the patient to surgery early while the lesion is still localized.

FRANK L. HUSSEY, M.D.

Newer Methods of Pneumarthrography of the Knee with an Evaluation of the Procedure in 315 Operative Cases. ISAACORE MESSCHAN and W. H. MCGAW. *Radiology* 1947 49 675.

The authors analyze 315 operative cases in which pneumarthrography of the knee was done. Oxygen is recommended for pneumarthrography because it is quickly absorbed. From 80 to 120 c.c. of oxygen are injected under gentle pressure into the joint space after the usual antiseptic preparation of the knee. The findings in normal and abnormal pneumarthrograms are presented in detail. The pneumarthrogram is of special value in the diagnosis of abnormal menisci, fat pads, and bursae. These cases account for over two-thirds of the major lesions in internal derangement of the knee joint.

In other causes of internal derangement of the knee, the plain radiograms are usually of equal value for diagnosis. It is not necessary to use pneumarthrograms for the diagnosis of osteochondritis dissecans or chondrosis of the patella. Popliteal bursae occurred in 13.5 per cent of the present series of cases.

The pneumarthrogram was found to be accurate in 81.6 per cent of the cases. It is estimated that the clinical examination alone is accurate in about 70 per cent, thus the pneumarthrogram has achieved a greater accuracy than the clinical examination. Moreover, with the pneumarthrogram the type and completeness of the lesion can be predicted more accurately. With the combined use of clinical examination and pneumarthrograms accuracy can probably be achieved in 90 per cent of the cases.

FRANK L. HUMBY M.D.

Carcinoma of the Bronchus with Especial Reference to Its Treatment by Radiotherapy. L. M. SHORVOG. *Bull J Radiol* 1947 20 443

The author analyzes a series of 213 cases of carcinoma of the bronchus seen in Mount Vernon during the years from 1942 to 1946. Of the patients in this group 75 were too ill and their disease was too advanced to permit radiation therapy. Palliative treatment was given to 23, 2 of whom had had a recurrence after pneumonectomy. Four patients were given postoperative deep x-ray therapy, 3 after pneumonectomy and 1 after lobectomy and 111 received radical treatment.

The results of radiation therapy are evaluated under three headings: possibility of cure, prolongation of life and relief of symptoms. The possibility of cure is remote. Not one radically treated patient has survived longer than three years after completion of the treatment. The prolongation of life is a difficult thing to evaluate satisfactorily because it is difficult to decide when the malignant process actually started. Statistically the treated patients survived longer than the untreated ones.

Complete or marked relief of such symptoms as pain, cough, dyspnea, and superior vena caval obstruction is often obtained by radiation therapy. Some patients enjoyed a period of comparative normality.

FRANK L. HUMBY M.D.

Röntgen Therapy in Uterine Fibromyomas without Ovarian Sterilization. GEORGE E. FRANKEL. *Am J Roentg* 1947 58-798.

The author presents a report of 4 cases of uterine fibroids of the interstitial type which were treated by roentgen therapy following which normal pregnancies occurred. The ovarian regions were protected by lead and in none of the 4 patients was menstruation interrupted. In 2 of these, treatment was followed by a total of 6 pregnancies. All of the children were normally formed. The first woman had 4 healthy children, 3 of whom are living today. The second patient had 3 children of premature birth, which was believed to be due to accidental causes not related to the irradiation; one child is well at 7 years of age.

The third patient has never become pregnant but has menstruated regularly. The fourth patient received some treatments over the ovaries and had an interruption of menstruation for a period of 6 months. She then became pregnant at the age of 32 years, and again at 33; the child is now a healthy girl, 20 years of age.

The author believes that roentgen rays have a direct action on fibromyomas and cause a disappearance of the tumor without affecting the ovaries, and that healthy children may be born after treatment for uterine fibromyomas. FRANK L. HUMBY M.D.

Further Observations with Intravaginal Röntgen Therapy of Cancer of the Female Pelvis. W. WALTER WASSON and ROY GREENING. *Radiology* 1947 49-453

The authors discuss some of the failures of roentgen therapy of cancer of the female pelvis and offer certain procedures with the hope of better end-results.

It can be said that the ultimate goal in treating carcinoma of the cervix by irradiation is to deliver a dose of uniform distribution throughout the pelvis and of sufficient intensity to destroy the cancer cells.

After a description of the anatomy of the pelvis and a discussion of the merits of the various diagnostic methods, the authors deal in particular with the type of radiation therapy consisting of a combination of external and intravaginal roentgen therapy.

The external roentgen therapy is carried out with either 300 kv or 400 kv. In the average case, a dose of 5,500 roentgens may be delivered through 4 or 5 portals into the structures of the birth canal over a period of a few weeks without approaching the limit of skin tolerance. Since 4,000 roentgens within the tumor cells is probably the optimal amount, there remain 1,500 roentgens to be given either by intravaginal roentgen therapy or by intracavitary radium. According to the authors, one of the advantages of intravaginal roentgen therapy is that it offers a greater flexibility to administer this remaining dose of 1,500 roentgens.

The irradiation is carried out through cones of various sizes suited to fit the vaginal canal. Multiple portals are used for crossfiring directed at the cervix and the surrounding structures or only at the cervix and broad ligaments. Either 140 kv or 300 kv may be used. Care must be taken to avoid overlapping. If a cone of 3.3 cm in diameter is employed, a satisfactory irradiation of the pelvis in the transverse diameter is possible provided three areas are given in the transverse diameter or the pelvis can be covered in the anteroposterior diameter if three areas are given in this diameter. With the use of smaller cones, unexposed spaces will remain between the treated areas. The sum of the diameters of the areas treated must equal the diameter of the birth canal.

If a uniform irradiation of the cross section of the pelvis cannot be accomplished by the intravaginal roentgen therapy supplementary radium treatment

may prove necessary. This applies especially to carcinomas of stages II, III and IV. Radium should also be used in carcinomas of the early stage when there is a purulent discharge present.

The authors have tried larger tumor doses than 4,000 roentgens per series of treatments but some delayed reactions were encountered about the cervix and vaginal vault. It is recommended that if a tumor dose of 5,000 roentgens is given in one series it should not be repeated at least in that same amount.

Intravaginal roentgen therapy is also of value in residual tumors following operations upon the uterus and ovaries or about the cecum, bladder and rectum. It is possible to crossfire the tumor in such instances through the vagina and by external irradiation.

T. LEUCUTA, M.D.

MISCELLANEOUS

The Biologic Effects of Fife Radiations. P. S. HENSHAW, E. F. RILEY and G. E. STAPLETON. *Radiology* 1947 49 349

The authors report results of experiments carried out at the Clinton Laboratories, Oak Ridge, Tennessee, as part of the extensive biological program of the Manhattan Project.

Experiments were carried out with several strains of mice to determine the late effects of periodic and single exposures of fast neutrons, slow neutrons and gamma rays (penetrating radiations). Similar experiments were carried out with beta rays, the absorption of which was limited almost exclusively to the skin.

In general, the late effects resulting from exposure to penetrating radiations, irrespective of the method of exposure, consisted of generalized atrophy and neoplasia of hemopoietic organs. Both effects were attended by a shortened life span, loss of weight

some increase of tumor incidence in organs other than hemopoietic, a modified blood picture and a changed pathology and histology all of which served as criteria of irradiation effects. It was plain that the chain of events between treatment and death did not always follow the same pathway even with identical treatments and animals of uniform type.

Survival time, which was one of the most sensitive responses, showed effects following daily exposures in the range of 0.1 neutron of fast neutrons and 1 roentgen of gamma rays. Threshold responses of the peripheral blood were often less sensitive than threshold survival responses in C57 mice. Slight differences were observed in different strains. No fundamental differences were observed in the responses of the different sexes.

The r/n ratio of gamma rays to fast neutrons for the different effects varied roughly from 8 to 1 to 35 to 1 for the conditions and methods used. The degree of acute damage (as measured by survival after single massive dose exposures) varies not only with dose but also with the intensity of irradiation, a 10-fold increase in exposure time for gamma ray treatment reduced the effects observed for a given dose to about 70 per cent. Thus the degree of biologic effect varies not only with the dose but also with the density of ionization produced. The incidence of lymphoma was increased from 15 per cent in controls to over 60 per cent following single exposures of from 500 to 700 roentgens of gamma rays. Lung tumor incidence was increased little if any.

Sublethal doses of beta rays produced skin lesions especially malignant types in rats and mice. Following doses of from 4,000 to 5,000 roentgen equivalent physical animals that ordinarily have no skin lesions showed skin carcinomas. It is significant that hemopoietic tissue tumors were obtained with penetrating radiation and skin tumors with surface absorbed radiations.

JOHN A. COCKER, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Amino Acid Utilization. PAUL R. CANNON *J Am Med Ass* 1947 35 943.

Rats, previously prepared by a diet low in protein but adequate in calories, vitamins and minerals, were used to test the speed of tissue synthesis under varying nutritional conditions. Tissue synthesis proceeded in direct relation to calories when repletion diets adequate in protein content but with varying caloric levels were fed. When the caloric content of the standard repletion diet was below 70 per cent recovery of weight was poor when it was above this level the addition of extra calories had but slight additive effect. In other words, tissue synthesis requires enough calories to facilitate the conversion of amino acids into tissue protein but above a certain level additional calories are superfluous.

Calories, per se do not build tissues. They are built from dietary proteins by conversion of their amino acids. Protein depleted rats which were fed a series of standard high caloric repletion rations each containing a decreasing amount of high quality protein regained their weight and appetite in direct relation to the protein content. These experiments demonstrate that for effective recovery of lost weight or for the regeneration of plasma protein and hemoglobin, high quality protein and calories are mutually indispensable, and a deficiency of either one may constitute a limiting factor which hampers effective convalescence. Vitamins and minerals must also be restored as well as the enzyme systems which in the debilitated patient may be severely impaired.

It is suggested that tissue protein synthesis is rapid and "all or none" in character when once it starts. One might presume that the synthesizing mechanisms may operate effectively only under the following general conditions: they must have available all essential dietary elements; the synthesizing cells must be uninjured if they are to obtain the energy necessary for the task of synthesis; conditions must be such that these cells, once the synthesis starts, can do a perfect job.

That presumably there is an overall proportional relationship between the various amino acids is suggested by the work of Beach and of Bailey: thus, for example, for every molecule of tryptophane required for the synthesis of muscle protein a certain specific number of molecules of the other essential amino acids are required. Examination of the high quality proteins which promote good tissue synthesis reveals that they contain such an assortment of essential amino acids, and that in the process of tissue synthesis, they may be made available to the synthesizing mechanism in proportional amounts. This relationship becomes of extreme importance because of accumulating evidence of the lack in the tissues of

reserves of individual essential amino acids. The phenomena of negative nitrogen balance appear so quickly with the removal of a single essential amino acid from the diet and disappear with equal speed when it is restored that it is difficult to postulate the ready availability of any essential amino acid reserves. In the absence of a single essential amino acid tissue synthesis stops; the remaining essential amino acids are presumably converted into glucose or are deaminated and excreted, and the synthesizing mechanism, rather than fabricating imperfect tissue protein, waits until a complete assortment is again available. Elman's work with the intravenous injection of acid hydrolysate of casein supplemented with tryptophane immediately and 6 hours later which revealed nitrogen retention in the first instance and lack of it in the second, is cited in support of the author's idea.

Two standard rations containing differing sets of essential amino acids when fed to rats at a hour intervals revealed that the animals could not eat the two rations quickly enough in relation to one another to enable the second group of essential amino acids to combine with the first group in order to accomplish tissue synthesis. Therefore, it is suggested that all the essential amino acids must be present at approximately the same time, for the individual amino acids from an incomplete ration cannot be stored in the liver or elsewhere for much longer than an hour. Thus the utilization of amino acids in tissue fabrication is extremely rapid and for optimal utilization each meal should be well balanced as to content and proportions of essential amino acids. The poorer nutritive value of vegetable proteins—soy beans, for example—may well be explained on the basis of their unequal rates of enzymic digestion and the correspondingly unequal rates of absorption of amino acids.

Protein hydrolysates and protein concentrates, assuming that these products contain all the essential amino acids in adequate amounts and proportions are seen to possess certain theoretic advantages in surgical practice, although it must be remembered that their complete utilization still depends on the efficiency of the synthesizing mechanism.

ALLAN D. CALLOW M.D.

Metabolic Disturbances after Injury. J. BRATHEN. *Brit Med J* 1947 3 3.

Only within the last 20 years has the metabolism of injured persons been studied accurately. One of the most significant findings concerns nitrogen metabolism. Following injury the average well nourished individual excretes an increased amount of nitrogen in the urine. This output increases to reach a peak at the end of the first week. Then it gradually declines to a normal level, attained in less severe injuries by the end of 2 or 3 weeks. The output may

decline still further but it rises again to a normal level by the end of 2 or 3 months. Thus it can be seen that there are catabolic and anabolic phases in the cycle of nitrogen metabolism evoked by an injury. The initial catabolic phase may be lessened but cannot be abolished by high protein diets given in the first week or 10 days after injury. Continuation of such diets will effect a positive nitrogen balance during the latter half of the period of high urinary nitrogen loss. The magnitude of the urinary loss is dependent on the individual's state of nutrition and on the severity of the injury. Poorly nourished patients have only a slight metabolic response or none at all as measured by urinary nitrogen loss. Even given high-protein diets such patients do not lose appreciable amounts of nitrogen in the urine. The fact that they do not catabolize the added protein suggests that the mechanism for the catabolic response has been inhibited. A severe injury such as occurred in the case of burns of hands and arms quoted by the author may have a marked negative nitrogen balance for a long time in this case, the loss was 216 gm. over a period of 47 days.

The mechanisms involved in these metabolic disturbances are not known. A small part of the negative nitrogen balance may be ascribed to the effects of immobilization as normal individuals kept in bed for weeks show a negative balance. However this is a relatively minor factor. The source of the nitrogen loss seems to be dispensable nitrogen which is "stored" in the body cells; this can be used as it is needed without loss of cell viability. Some observers have calculated that at least 15 per cent of the body nitrogen is in the dispensable category. It appears that when this nitrogen has been lost some factor operates to check the loss. Thus after injury in poorly nourished individuals there is no catabolic phase of nitrogen metabolism because this protective mechanism is already at work. In well nourished individuals the urine contains large amounts of corticosteroid material a few days after injury presumably derived from the adrenal cortex. It is thought that this inhibits the synthesis of amino acids into proteins. Consequently if these acids are not utilized by the body but are deaminated by the liver and in part built into liver glycogen their nitrogenous fraction is transformed into urea and excreted. In debilitated patients the urine does not contain these large amounts of corticosteroid material. Cuthbertson has advanced an interesting hypothesis that the increased nitrogen output may result from the breakdown of protein molecules in the body's attempt to supply some component amino acid of the protein molecules which is essential to the process of repair. If this one amino acid makes up 3 per cent of the protein molecule the remaining 97 per cent would have to be metabolized.

After injury there is greater need for vitamin C. Some of this may result from an increased utilization of ascorbic acid by the adrenal cortex. Some of the increased need may be due to an increased requirement in the liver where ascorbic acid is known to

augment the enzyme arginase which appears to be concerned in urea production. Some of the increased demand is known to be due to the requirements of the injured tissue for repair.

Excretion of calcium after injury is greatly increased in the urine and moderately increased in the feces. Following fractures the increased output of calcium may reach a dangerous level since insoluble calcium phosphate may be precipitated in the urinary tract to form calculi.

BENJAMIN F. LOUGSBURY, M.D.

Effects of Tetraethyl Ammonium Chloride on a Mixed Type of Hypersensitive Carotid Sinus Syndrome ROBERT D. TAYLOR, LEX C. UNDERWOOD and IRVING H. PAGE. *J. Lab. Clin. Med.*, 1947 32: 1491

A 59-year-old man who had a hypersensitive carotid sinus syndrome was observed. Stimulation of the sinuses by pressure caused bradycardia, reduction of the blood pressure, giddiness and syncope. The bradycardia was presumably due to increased vagal tone and the fall of the arterial pressure to vasodilatation of sympathetic origin. Atropine sulfate by its ability to inhibit parasympathetic activity blocked the vagal component but had no effect upon the sympathetic component. Tetraethyl ammonium chloride which paralyzes both parasympathetic and sympathetic ganglia prevented both responses.

The inhibition of the sympathetic nervous system by tetraethyl ammonium although more complete than that of atropine is of brief duration; it is not recommended for the treatment of the hypersensitive carotid sinus syndrome of this type.

WALTER H. NADLER, M.D.

Pathologic Anatomy in 2 Cases of Myasthenia Gravis (Anatomia patologica de dos casos de miastenia grave) PEDRO I. ELIZALDE and JUAN R. MANGUILL. *Rev. As. Méd. Argent.* 1947 61: 661

Other authors have found lesions of the thymus gland associated with myasthenia gravis in almost 50 per cent of their cases.

The pathologic findings in 2 cases of myasthenia gravis in which tumors of the thymus were found are reported by the authors. In the first case a thymoeplithelioma was found measuring 4 by 3 cm. in a 40-year-old male. The tumor was ovoid, hard, encapsulated, easily enucleated, of a whitish fatty color and its cut surface showed several small pin-head-sized cavities.

On microscopic examination there was a blastomatous proliferation formed exclusively by epithelial cells with numerous nuclear anomalies which infiltrated the neighboring cellular tissues and reproduced the thymic matrix, and in doing so destroyed the host tissue.

In the second case the thymus was the size of a hen's egg. The cut surface was of a whitish red color and the gland was lobulated in parts. This case was a hyperplasia of the thymus, which on microscopic examination revealed a rich capillary

bed with nuclei far apart and a collagenous mass of the capillaries easily traversed by the thymus cells. In the areas of the capillary anastomoses there were trabeculae of active proliferative thymoblasts. There were also outlines of young epithelial cells, which formed nuclei in concentric patterns, and thymoblasts with acidophilic protoplasm which were homogenous some had clear vacuoles. The process is that of a neoformation in which epithelial cells of the stroma show an intense proliferative activity to which is added the presence of large and small thymic cells.

ARTHUR F. CIRIOZZA, M.D.

Neurovascular Syndrome of the Arm Associated with Hypertrophied Subclavius Muscles: Report of a Case Including Operative Treatment.
ROBERT E. CLIFFTON Arch. Surg. 94:7 55 732

A case of dysfunction of the left upper extremity simulating in great detail the scalenus anticus syndrome is presented. In the present case the neurovascular syndrome of the left upper extremity was the result apparently of a hypertrophied subclavius muscle and costocervical fascia secondary to a fractured clavicle which had healed by bony union and without significant deformity 5 years previously.

The symptoms and findings persisted from the time of the accident (December 25, 1910) until operative relief was achieved at the Wakeman General Hospital, Camp Atterbury, Indiana (now disbanded) in 1945. Repeated examinations at several Army hospitals preferred the diagnosis of scalenus anticus syndrome.

In repeated examinations at the Wakeman General Hospital by neurologists, neurosurgeons, and orthopedists, the following observations were consistently made:

The general physical condition was essentially normal. This soldier was lean and wiry but had well developed muscles, especially about the shoulders. There was moderate dilatation of the veins of the left arm and shoulder. The left hand and forearm became cyanotic when the arm was dependent, with the cyanosis most pronounced over the hand and wrist and shading off to normal color above the elbow. The left hand was definitely colder than the right. With elevation the cyanosis slowly disappeared in from 3 to 5 minutes and the hand and the arm blanched more and more and remained cold. There was definite weakness of the left arm and hand (60 to 70 per cent) as compared with the right. The patient was able to elevate the arm just to an angle of 90 degrees but was unable to hold it there for more than a few seconds. It then slowly and steadily fell despite evident effort. The radial pulse was of good quality but was completely obliterated with elevation of the arm to an angle of 40 degrees. It then again gradually became apparent at an elevation of 70 degrees, but was obliterated at an elevation of 90 degrees.

Venographic studies were done 30 c.c. of diodrast being used. Roentgenograms were taken after the injection of 1 and 30 c.c. of diodrast, and in 15 sec-

onds after completion of the injection. Because of the complete block still present a fourth roentgenogram was taken about 10 minutes after the development of the previous 3 roentgenograms. This showed a complete obstruction still present, with moderate collateral filling of the veins. At operation a large hypertrophied subclavius muscle appearing to be two to three times the usual size, was found. As the subclavius muscle was rolled out from beneath the clavicle it was noted that distention in the cephalic and subclavian veins was released. The brachial plexus, the subclavian and axillary arteries and the subclavian and axillary veins were carefully explored from well above the clavicle to below the insertion of the pectoralis major and no other unusual condition was noted.

Dysfunction of an upper extremity due to pressure on vascular and nerve elements in the region of the shoulder are not uncommon and are disabling. It is likely that a predisposing cause lies in an unusual anatomic relationship with narrowing of the costoclavicular space and/or enlargement and hypertrophy of the subclavius muscle, and hypertrophy of the costoclavicular fascia, or in some instances, of the subscapularis muscle. Diagnosis is made by observation of the typical symptoms and signs, and by venographic study which gives a typical picture of obstruction of the flow of opaque medium, usually in the region of the clavicle and first rib, and filling of collateral channels. Operation is believed to be justifiable in a larger number of cases in view of the consistently good results reported. Marked improvement followed the relief of pressure by section of the subclavius muscle in this patient.

JOHN H. MORRIS, M.D.

The Intracellular Mode of Action of the Sulfonamide Derivatives. R. A. Q. O'NEILL, P. A. MC NALLY and H. G. NELSON. *Lancet*, Lond. 1947: 747

How sulfonamides interfere with bacterial metabolism has been studied by the authors in experiments utilizing *Bacterium coli* in urine as a culture medium, and *Streptococcus pyogenes* in meat-extract-peptone broth, to both of which were added 0.3 per cent glucose and 0.1 per cent sodium bicarbonate. Sulfonamides produce their characteristic effects on bacteria by interfering with their metabolism in the so-called "logarithmic" or most rapid phase of bacterial growth. During this phase of maximum bacterial metabolism one of the metabolites produced is a diol compound, probably glucoreductone, which is unstable and highly reactive but unites readily with para-aminobenzoic acid to form a stable, nonreactive compound. This is readily hydrolyzed, when it liberates its original components. Therefore para-aminobenzoic acid appears to be a stabilizing agent which enables the bacterial cells to store glucoreductone as it is formed and to utilize it as it is required. In so doing it prevents the loss of an intermediate metabolite essential during growth and keeps this reactive sub-

stance from exerting a toxic effect on the cells. Other aldehydes and ketones may be similarly stabilized by condensing them with para-aminobenzoic acid. The importance of glucoreductone to bacterial growth has been demonstrated by finding that the acid is utilized by streptococci as a source of growth energy.

The sulfonamides condense with glucoreductone almost as readily as does para-aminobenzoic acid. Their condensation products are not utilizable by streptococci as a source of energy for growth. It is believed that the sulfonamides act within the bacterial cells during their active metabolism by combining with glucoreductone (and possibly other active metabolites) and thus render it unavailable for use by the cells. This deprivation may be fatal to the cells during their active growth for the entire cellular metabolism is suddenly stopped at the very point where it has become adjusted for the special purpose of reproduction.

BENJAMIN F. LOUNSBURY M.D.

Absorption of Penicillin Given by Mouth II C SEIZWART AND J. R. MAY *Lancet* Lond 1947 2 85

The various factors believed to influence the absorption and excretion of penicillin when taken by mouth were investigated carefully in 16 adult healthy males without evidence of infection. A standard dose of 15,000 units administered in about 4 ounces of water was usually used and the subjects were quickly found to be good or poor absorbers of penicillin. The greatest absorption occurred in the duodenum and jejunum with none of significance occurring in the buccal mucosa. It is greatest in the absence of food, although satisfactory levels may be obtained if meal. To cause any appreciable destruction of penicillin within 40 minutes the gastric juice must be of a pH of 3 or less. This time factor is important because in 13 of 15 experiments in 6 persons the peak blood level was found to have occurred at or before this time. Therefore, unless the gastric juice is of a pH of 3 or less no significant destruction can be attributed to it by the time the peak blood level has been reached. Since the number of persons with a resting gastric pH of 3 or less appears to be considerably less than the number of persons who absorb penicillin indifferently it seems unlikely that destruction of penicillin by acid gastric juice can be the only factor concerned.

The use of antacids appeared to be of benefit only in preventing the gastric contents from being at a pH of 3 or less although it is pointed out that slightly alkaline fluids traverse the stomach more rapidly than do acid ones. Thus the use of antacids may facilitate absorption as much by favoring the rapid passage of the drug into the small intestine as by neutralizing the gastric acidity. The water soluble ones are of greater usefulness than the insoluble ones, and indeed kaolin and magnesium trisilicate were found to cause the penicillin to be adsorbed by

them and to adhere to the gastric mucosa. Capsules gave no greater blood levels. Enteric coated ones gave lower values possibly by causing the penicillin to be liberated farther down the gut in an area of poor absorptive power.

Duodenal aspirations revealed no penicillinase and ileal contents save for insignificant amounts in the latter. The authors conclude that it seems very unlikely that penicillinase activity could play any part in the absorption of penicillin by mouth. Of penicillin types I, II, III, and K, no one type was better absorbed than the others. The combination of glucose with penicillin was disappointing although in a few instances the levels were higher and better maintained. Glucose did not produce a consistent improvement in the poor absorbers however. McDermott has stated that in order to produce satisfactory levels with oral penicillin 5 times the dose of intramuscular therapy must be utilized. Because of the possibility that one may be dealing with a poor absorber these authors believe that at least 10 times the intramuscular dose should be used when oral administration is utilized.

If penicillin is to be given by mouth the following suggestions are made: it should be given in about 4 ounces of water with about 30 gr of sodium bicarbonate or citrate before meals and not less than 3 hours preferably 4 hours after the previous meal. The dose should be 10 times as great as the dose of intramuscular penicillin that produces the desired blood level. If this is to be maintained continuously a dose of 500,000 units by mouth should be satisfactory.

The most important factor influencing the absorption of penicillin seems to be the unexplained individual variations in the absorptive capacity of the gut.

ALLAN D. CALLOW M.D.

Sarcoidosis: A Clinical and Roentgenologic Study of 28 Proved Cases. JAMES J. MCCORT, RICHARD HUGH WOOD, JOHN B. HAMILTON, and DAVID E. ENGLISH. *Arch Int Med* 1947 80 793

While serving in an army general hospital functioning as a center for radiation therapy the authors proved clinically and histologically 28 cases of sarcoidosis. They state that the most pressing problem in the diagnosis of a mediastinal tumor is the differentiation of benign from malignant lymphogranuloma. The factors bearing on this differential diagnosis are presented in this article.

Little is known of the pathogenesis of the disease. Tubercle bacilli have been found by several workers in sarcoid lesions and concomitant diseases are still under question. Tubercle bacilli in sarcoid lesions have been reported by several writers. In a number of cases followed up over a period of years frank tuberculosis has been seen to develop in conditions clinically and histologically diagnosed as sarcoid. The development of tuberculosis is one of the frequent causes of death and the relationship is thought

to be more than coincidental by most writers but definite proof of the tuberculous nature of sarcoid is still lacking. Sarcoid lesions have been found in the tonsils, brain, spleen, lung, myocardium, pericardium, kidney, small intestines, testicles, and epididymis.

In all the cases presented in this article the diagnosis was made by histologic examination and confirmed by the Army Medical Museum. Enlargement of the peripheral lymph nodes is common and accessible lymph nodes can be removed easily. The cervical nodes have been the optimum site of biopsy in the authors' cases. The authors recommend a voiding the inguinal glands. They have successfully removed biopsy material from the tonsils, parotid glands, lacrimal glands, skin and mediastinum. Aspirate on biopsy from the liver has been reported as very successful when other sources were not available.

Microscopically there is proliferation of the epithelioid cells with the formation of granulomas. Giant cells of the Langhans type are present. In the lymph nodes the granulomas are arranged in clusters which may fill the entire node, but they usually do not break through the capsule. The center of these tubercles may show slight necrosis, but true caseation is rare.

There is no evidence of depression of hemopoiesis in the bone marrow. In the liver it has been found that the lesions of sarcoid are more numerous in the portal triads.

The manifestations of this disease are many and varied because of the number of organs and tissues which may be involved. About four clinical types are recognized: (1) with sarcoids of the skin; (2) with neoplasms of the skin; (3) with lymphadenopathy of the superficial or intrathoracic nodes, and (4) primary involvement of the pulmonary parenchyma, as shown by roentgenograms which may closely resemble those of pulmonary tuberculosis.

The patients whose cases are presented were admitted to an army general hospital between July 1, 1943 and April 1, 1946. All the patients had intrathoracic lymphadenopathy and all except 3 had enlargement of the superficial lymph nodes. Because of the selection 7 were men (in other series the sex incidence is equal). The majority of the patients have been in the young adult group. It is significant that 15 of the 38 patients were negroes which is in accord with the experience of other investigators.

The symptoms these patients presented were variable in degree but tended to be mild. Nine patients had cough which was persistent and only slightly productive. Only 3 had slight hemoptysis. 1 complained of dyspnea aggravated by exertion and 6 of them lost significant weight. Weakness, fever, anorexia, nausea, and vomiting were occasional symptoms. Six patients had no symptoms whatsoever. It was observed that cough and dyspnea were the most frequent presenting symptoms probably because all the patients had intrathoracic disease. Peripheral lymph nodes were enlarged in 26 of the 38

cases. The nodes were small and discrete and were not confluent. The nodes were often insignificant although they were found to be involved. Eleven patients had eye involvement, most often a uveitis or iridocyclitis, but any or all of the eye structures may be involved. Moderate enlargement of the spleen was found in only 3 cases. There was a low incidence of cutaneous lesions. The fever was usually of low grade and continued over several days or weeks, lasting 3 months in one case.

The most consistent laboratory observation is that the tuberculin skin test is negative in the majority of cases. When a positive reaction occurs it is usually weak and it occurs only with the higher concentrations. This test is valuable in a differential diagnosis. Another significant symptom is the elevation of the globulin fraction of the blood protein. It was elevated in 23 of 38 patients in this series. No instance of a false positive reaction to a serologic test for syphilis was noted. There were no other significant laboratory findings.

In all 38 patients there was evidence of intrathoracic lymphadenopathy which is not easy to detect. Examination should include careful roentgenoscopy with swallowed barium. A posteroanterior and a lateral view and if necessary oblique views should be taken. Usually nodes of 1 cm. or greater in diameter will be detected. In this series most nodes ranged between 2 and 5 cm. in diameter. Like the peripheral nodes, the intrathoracic nodes tend to remain discrete and have a tendency to coalesce. In the roentgenogram the tumor will show a lobulated border giving strong evidence that it consists of a group of enlarged lymph nodes. Calcification in or about the nodes was noticed but once. In no instance was there evidence of lobular collapse. There was no involvement of the esophageal wall or involvement of the phrenic nerves, which is not unusual in bronchiogenic tumor.

Enlargement of the intrathoracic lymph nodes is found in the vast majority of cases of sarcoidosis. In contradistinction intrathoracic lymphadenopathy is a less frequent finding in malignant lymphoma. Later in sarcoidosis the nodes regress slowly and spontaneously to be replaced by fibrous tissue. This has been confirmed by autopsy. In malignant lymphoma the process tends to break through the capsule and invade the surrounding structures.

The roentgenographic appearance of the chest in erythema nodosum can be confused with sarcoidosis, as can pulmonary coccidioidomycosis; however the skin test for coccidioides is helpful for diagnosis.

In this study the earliest manifestation of the disease seemed to be enlargement of the intrathoracic lymph nodes. After a variable time, these tend to regress spontaneously while parenchymal involvement apparently increases. About equal involvement of both lungs is the rule.

No definite pattern of lung changes in sarcoidosis can be predicted. Pulmonary parenchymal involvement was seen in 15 of the 38 cases, the true incidence probably being higher than this figure. Lung

involvement is of two main types which are frequently coexistent. The first and commonest is reticular with thin strandlike areas of increased density extending out from the hilus. Less frequently a nodular increase in density throughout both lung fields is observed and may be confused with milary tuberculosis. In this series the authors were unable to correlate the degree of pulmonary involvement with the severity of the symptoms.

Involvement of the heart and its covering has been reported and 1 patient of this series had pericardial effusion requiring 4 pericardial taps. Two patients had slight pleural effusion. There was no involvement of the bony thorax. Six patients had lesions in the bones of the hands. None was found in the feet or any long bones. None of the patients with hand involvement had symptoms.

Treatment was not discussed except that after 2 patients were given radiation therapy the authors concluded that it was of no value in the treatment of the enlarged lymph nodes of sarcoidosis.

There was but 1 death in this series due to failure of the right side of the heart secondary to extensive infiltration of the lung.

DAVID H. LYNN M D

GENERAL BACTERIAL, PROTOZOAN AND PARASITIC INFECTIONS

Staphylococcal Infection Due to Penicillin Resistant Strains. MARY BARBER. *Bris M J* 1947 3 863.

The incidence of strains of the *Staphylococcus pyogenes* that are grossly resistant to penicillin is increasing so rapidly as to be somewhat alarming. In a previous study of 200 patients yielding cultures of the *Staphylococcus pyogenes* penicillin resistant strains were isolated from 25 (12.5%). In a recent series of 100 patients with *Staphylococcus pyogenes* infection 35 yielded penicillin resistant strains.

The degree of resistance in all 38 cases was gross and all except one strain which was not tested were shown to produce penicillinase. Thirty-six of the patients had a sensitivity to streptomycin 2 not being tested and 1 being treated for tuberculous meningitis with streptomycin to which there was resistance. In most of the 38 cases, the *Staphylococcus pyogenes* was the only or at least the pre-dominant organism isolated. In 10 patients, both penicillin-sensitive and penicillin resistant strains of the *Staphylococcus pyogenes* were isolated from the same specimen.

The main cause for this increase in penicillin resistant strains of the *Staphylococcus pyogenes* is the widespread use of penicillin although a patient yielding such an organism may not himself have ever had any. As stated in a previous publication the author believes these strains are not originally sensitive *Staphylococci* which have acquired a resistance to penicillin by contact with it, but are naturally resistant strains which survive by a simple process of selection in penicillin treated infections. That such changes in bacterial flora take place during the

course of penicillin treatment is becoming increasingly clear and is well illustrated by 5 cases of lung infection.

In some cases penicillin resistant organisms are clearly present but are overgrown by sensitive strains until penicillin treatment leaves them a clear field by getting rid of the latter. In any hospital using large quantities of penicillin bacteria resistant to its action are probably increasing at the expense of those that are sensitive. This is illustrated by the fact that in a particular unit of the hospital the percentage of penicillin resistant strains was higher throughout the two investigations, which showed that a penicillin resistant strain of the *Staphylococcus pyogenes* once it gains a foothold in the hospital may spread from patient to patient.

The best method for the detection of penicillin resistant bacteria is to plate out the infected material directly on to a penicillin ditch-plate with a concentration of about 10 units of penicillin per milliliter of agar in the ditch. By this method some information as to both the degree and the type of resistance is obtainable.

DAVID H. LYNN M D

EXPERIMENTAL SURGERY

The Role of Leucotaxine in the Production of the Anhydremia of Burn Shock. H. CULLUMBER, F. McDONALD and M. M. SIMPSON. *J Path. Bact., Lond.*, 1947 50 467.

A polypeptide of comparatively low molecular weight and capable of causing increased capillary permeability has been described in inflammatory exudates from various sources. This polypeptide was called 'leucotaxine' and appears to be liberated after injury at the site of the local damage. None has been detected in the blood of burned animals and it is known to be destroyed on incubation with blood serum or plasma. Its local production at the site of injury might be a factor in the causation of the decreased blood volume and anhydremia found in burn cases. The experiments reported here were designed to see if the systemic picture of anhydremia could be reproduced by the localized injection of crude preparations of leucotaxine into the skin. Also observations on the toxic properties of the edema fluids produced by the subcutaneous injection of leucotaxine and by burning have been made.

The methods are described with the use of rabbits. The average results show that the groups of burned rabbits and of those receiving fibrin or skin leucotaxine hypodermically show substantially the same blood picture. The red blood cell count, the blood hemoglobin content, and the blood specific gravity all show a marked increase within 4 hours of injection or burning. This increase is followed by a fall to lower than preinjection or preburning levels. Similarly, both the burning of the skin and the subcutaneous injection of leucotaxine are followed by a marked rise in the blood sugar level, a more sustained rise in the blood urea level, and a fall in the plasma protein content.

Control groups of rabbits receiving isotonic saline hypodermically or nembutal intraperitoneally did not exhibit this blood picture. Neither did a group which received 60,000 units of fibrin leucotaxine intravenously. Here, if anything, a picture of hemodilution was produced.

It can be said that about 60,000 units of leucotaxine can be extracted from 150 sq. cm. of rabbit skin burned at 70° C. for 90 seconds, and that the subcutaneous injection of 60,000 units of this leucotaxine into normal rabbits causes marked local edema and reproduces substantially the blood picture that follows burning of the skin.

The authors confirmed the results of Wilson *et al.* who have described the toxic properties of the edema fluid obtained from the burned skin of rabbits. It would seem that the edema fluid produced by the subcutaneous injection of leucotaxine contains a factor with a toxicity similar to that found after burning. The toxic factor in the edema fluid is not found up to 24 hours after burning but is usually present after 48 hours. GEORGE W. RICHARDSON, M.D.

Development of an Artificial Kidney: Experimental and Clinical Experiences. GORDON MURRAY EDMUND DELORME, and NEWELL THOMAS. *Arch. Surg.* 94:7 55 505

The authors report deals with the development of an artificial mechanical kidney the function of which is to remove from the blood stream circulating toxic substances. The present investigation was based on experiments performed in 1933, 1934 and 1935 with moderate success, using heparin as an anticoagulant and kidney transplantation from one animal to another and from one species to another.

It seemed possible that if a patient could be protected from death from toxemia in such conditions as acute poisoning by mercury and phenol in the tox-

emia of acute infection, such as nephritis or pneumonia with oliguria or anuria, as well as in acute anuria following blood transfusions, administration of excessive sulfonamide drugs, eclampsia and toxemia of pregnancy, severe cutaneous burns, induced abortions and acute injury to ureters and kidneys from calculous obstruction reflex or otherwise, or operation after a time there would be sufficient recovery in a number of cases so that the affected kidneys might resume function.

After extensive and arduous trials and experiments, an apparatus was finally devised and described which apparently works smoothly for long periods and performs the functions for which it was developed. The successive stages in perfecting the apparatus are described.

A detailed description is given of a patient who had anuria for 9 days secondary to an attempt at induced abortion. During this period the patient was passing about 35 c.c. of urine daily and when first seen had uremia, was comatose, edematous, and having mild uremic convulsions. The condition seemed hopeless. On the ninth day the patient was attached to the artificial kidney by passing a catheter through the saphenous vein into the inferior vena cava on the right side and another into the femoral vein on the left. With repeated runs, the patient recovered and is now in good health.

A report is made, after a great deal of experimental work, of an artificial kidney or dialyzing membrane which has been used in such a way that it can be applied safely to animals or to human beings. This membrane can be used to remove toxic substances from the blood. With proper huffing of the dialysate there are no injurious effects as a result of this dialyzing process. A clinical case is described in which cure was effected.

JOHN H. MICHARDT, M.D.

SURGERY

GYNECOLOGY AND OBSTETRICS

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THE HEALING OF BOWEL AS INFLUENCED BY SULFASUXIDINE AND STREPTOMYCIN

EDGAR J POTH M.D. Ph.D. F.A.C.S. JOSEPH P McNEILL, M.D.

LOUIS J MANHOFF, Jr. M.D. WALTER B KING M.D. and

JOHN G SINCLAIR Ph.D. Galveston Texas

THE value of sulfasuxidine and sulfathalidine since their introduction as intestinal antiseptics in 1941 (1) and 1943 (2) respectively has been repeatedly and amply demonstrated in both the clinical and experimental use of these bacteriostatic agents. Oral streptomycin has been suggested for a similar purpose more recently by Zintl, Wiley Nichols and Rhoads.

It has been demonstrated previously that these sulfonamides favor the healing of the colon in dogs (3) following anastomosis. Now with the introduction of streptomycin as an intestinal antiseptic to effect an alteration of the bacterial flora its influence upon bowel healing is likewise being studied. Two types of anastomosis are studied. Series A an open technique using a single, continuous row of chromic catgut placed through the entire thickness of the wall of the colon and Series B a so-called aseptic procedure using two rows of sutures which include the submucosa but which do not penetrate the mucosa.

PROCEDURE

Forty four selected dogs are divided into two groups and placed on a diet of ground

From the Surgical Research Laboratory and the Department of Anatomy University of Texas Medical Branch, Galveston, Texas.

Presented in the Forum on Fundamental Surgical Problems before the Clinical Congress of the American College of Surgeons, New York, September 8-11, 1947.

horse meat. Series A consisting of 30 animals and Series B of 14. These two series are each further divided into three: one portion to serve as controls, a second one to receive sulfasuxidine only and the others sulfasuxidine plus streptomycin.

The operative procedures used in Series A and B are illustrated in Figures 1 and 2 respectively.

The control animals for each series A and B received ground horse meat for 12 days preoperatively, a purge of magnesium sulfate the evening before operation and a diet of horse meat postoperatively after 24 hours.

The animals which received only sulfasuxidine were placed on a similar diet. They received 10 gram of sulfasuxidine per kilogram of body weight daily mixed with the meat which was divided into 6 portions and fed at 4 hour intervals for 12 days preoperatively and postoperatively after 24 hours.

In the case of the 12 animals receiving both sulfasuxidine and streptomycin the schedules were somewhat varied. At first it was desired to give streptomycin alone but it became evident immediately that the bacterial count while it was readily reduced, could not be maintained at a decreased figure (Chart 1). Therefore to test whether or not streptomycin altered bowel healing and to make a comparison with the other treated animals in this

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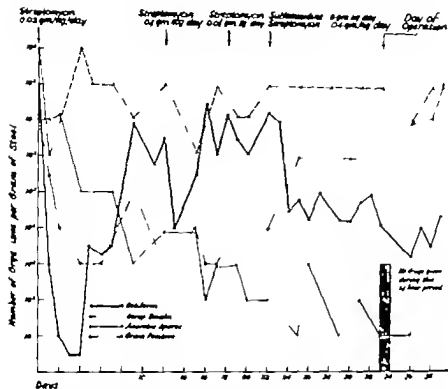


Chart The characteristic changes in the bacterial flora of the bowel of the dog following streptomycin administration in large doses are illustrated graphically. The coliform organisms decreased rapidly at first, but then they increased in resistance 3,000 fold. Following this increased resistance sulfasuxidine was still somewhat effective; the organisms showed increased resistance to this drug also.

study it was necessary to alter the bacterial flora with sulfasuxidine in the usual manner. Six of these animals received streptomycin for 33 days preoperatively. Another group of 6 animals received sulfasuxidine for 10 days plus sulfasuxidine and streptomycin for 2 days preoperatively and then both drugs postoperatively after 24 hours (Chart 2).

The animals which survived were sacrificed at 3, 5 and 7 days postoperatively at which time a complete autopsy was performed, colored photographs of all specimens taken, and the operative specimens preserved in 10 per cent formalin for subsequent microscopic section and study.

RESULTS

Series 1. Open anastomosis. The difference between the treated and control groups of experiments is characteristic, constant and easily recognized. The abdominal wounds of the animals which had received preoperative ther-

apy with sulfasuxidine or with sulfasuxidine plus streptomycin healed rapidly without evidence of infection in contradistinction to the controls in which edema, inflammation and infection were ordinarily present. Also when the abdomen was opened the control experiments were characterized by a diffuse peritoneal reaction, dense edematous adhesions of omentum and adjacent loops of bowel to the site of the anastomosis; the treated animals showed no evidence of peritonitis, and adhesions and edema were minimal.

On removal of the operative specimen great care was required to avoid disruption at the line of suture of the untreated colon. The specimens from the treated animals could be handled freely and required considerable pull to cause separation of the anastomosis. Opening the colon specimens longitudinally revealed a remarkable difference in the extent to which edema existed (Figs. 3 and 4). The edema of the mucosa extending 5 to 7 cent

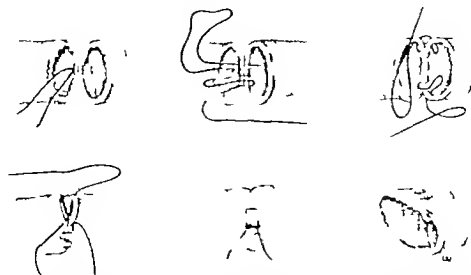


Fig 1 Open anastomosis (Series A) of descending colon of the dog. A single continuous row of No. 00 chromic catgut is placed through and through the full thickness of the bowel wall. A single interrupted suture of No. 00 chromic catgut is used to bury the knot of the continuous suture tied at the antimesenteric border.

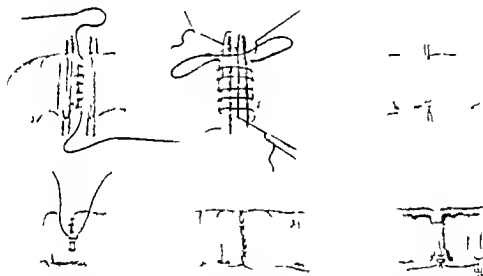


Fig 2 Closed, aseptic anastomosis (Series B) of descending colon of the dog. An inner continuous row of No. 00 chromic catgut is placed so as to include the submucosa without entering the lumen of the bowel as indicated. A second anterior and posterior row of interrupted fine black silk is placed to include the submucosa but not penetrate into the lumen.

meters on either side of the suture line in the controls was sufficient to cause from 50 to 90 per cent obliteration of the lumen of the colon. In contrast the edema in the mucosa of the treated animals was limited to within 2 centimeters of the line of suture and seldom caused as much as a 25 per cent reduction of the lumen of the bowel.

Grossly there was no difference between those animals receiving sulfasuxidine only and those receiving both sulfasuxidine and strepto-

mycin. Although gross infection was usually present and 3 of the 12 control animals died of peritonitis following perforation the most remarkable differences are evident upon microscopic study of the tissues at and near the anastomosis (Figs 5, 6, 7 and 8).

Series B Closed or aseptic anastomosis. The results in the control experiments in this series were superior to the controls of Series A. No deaths occurred. Nevertheless the process of healing in the treated and untreated

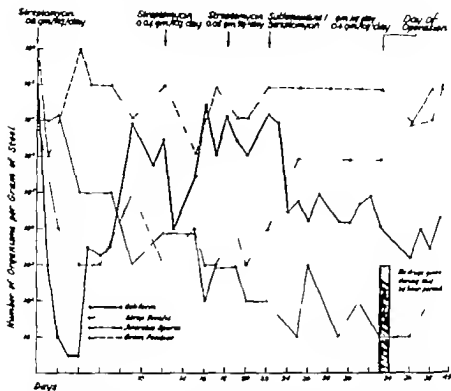


Chart 1 The characteristic changes in the bacterial flora of the bowel of the dog following streptomycin administration in large doses are illustrated graphically. The coliform organisms decreased rapidly at first, but then they increased in resistance 3,000 f. id. Following this increased resistance sulfasuxidine was still somewhat effective the organisms showed increased resistance to this drug also

study it was necessary to alter the bacterial flora with sulfasuxidine in the usual manner. Six of these animals received streptomycin for 33 days preoperatively. Another group of 6 animals received sulfasuxidine for 10 days plus sulfasuxidine and streptomycin for 2 days preoperatively and then both drugs postoperatively after 24 hours (Chart 2).

The animals which survived were sacrificed at 3, 5 and 7 days postoperatively at which time a complete autopsy was performed colored photographs of all specimens taken and the operative specimens preserved in 10 per cent formalin for subsequent microscopic section and study.

RESULTS

Series A Open anastomosis The difference between the treated and control groups of experiments is characteristic, constant and easily recognized. The abdominal wounds of the animals which had received preoperative ther-

apy with sulfasuxidine or with sulfasuxidine plus streptomycin healed rapidly without evidence of infection in contradistinction to the controls in which edema inflammation and infection were ordinarily present. Also when the abdomen was opened the control experiments were characterized by a diffuse peritoneal reaction dense edematous adhesions of omentum and adjacent loops of bowel to the site of the anastomosis the treated animals showed no evidence of peritonitis, and adhesions and edema were minimal.

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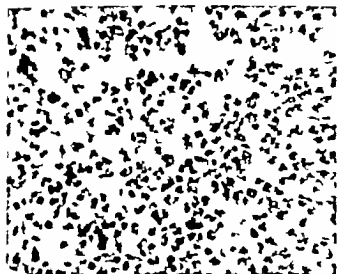


Fig 5

Fig 5. Microscopic section $\times 380$ taken from line of suture (Series A) from colon of a control dog on the 3rd postoperative day. The cellular elements are almost exclusively polymorphonuclear leucocytes with no evidence of fibroplasia or revascularization.

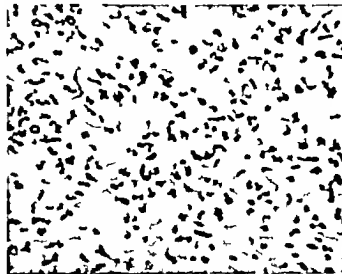


Fig 6

Fig 6. Control experiment same as shown in Figure 5 except that the specimen is taken on the 5th postoperative day. The formed cellular elements continue to be largely polymorphonuclear leucocytes with an occasional early fibroblast. Revascularization has not occurred.

Fig 7. Microscopic section $\times 380$ taken from the line of suture (Series A) from the colon of a dog which had received the standard ground meat diet and sulfasuxidine 2.0 gram per kilogram daily in 6 divided doses for 12 days preoperatively and again postoperatively after 24 hours until the animal was sacrificed on the 3rd postoperative day. Fibroplasia is proceeding in an orderly manner with well advanced revascularization. There is moderate polymorphonuclear infiltration.

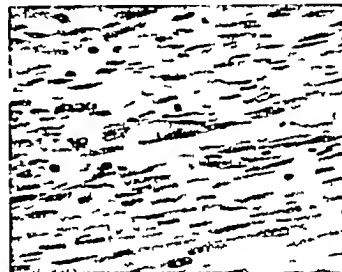


Fig 7

Fig 8. Same as Figure 7 except that the specimen was taken on the 5th postoperative day. Healing is continuing with orderly fibroplasia and revascularization. An occasional polymorphonuclear leucocyte remains in the healing tissue.

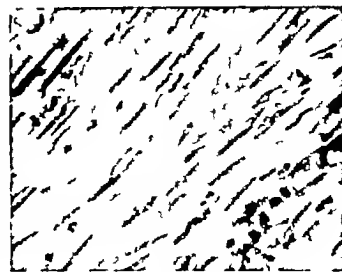


Fig 8

The difference of healing between the control and treated animals is so striking as to resemble secondary repair in the first instance and primary healing following the alteration of the bacterial flora.

The mechanical aspects of fecal material remaining in the bowel at the time of operation are important. In these experiments the long period of low residue diet magnesium sulfate given the control animals 12 hours before operation and a large dose of morphine 1 hour preceding anesthesia completely emptied the colon of the control animals. The treated animals received no purgation and a small quantity of liquid fecal material was present. No attempt was made to avoid gross soiling dur



Fig 3. Specimen P 29. Mucosal surface of the colon. Dog on ground meat diet and 1 gram per kilogram daily of sulfasuxidine in 6 divided doses for 3 days preoperatively. The same dietary and drug regimen postoperatively after 24 hours until the animal was sacrificed 3 days postoperatively. The arrows indicate the extent of the gross edema on either side of the line of anastomosis. There is clean healing at the line of suture.

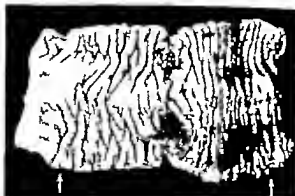


Fig 4. Specimen P 35. Mucosal surface of the colon (control). Dog on ground meat for 12 days preoperatively and postoperatively after 24 hours. Animal sacrificed 3 days postoperatively. The arrows indicate the extent of the gross edema on either side of the line of anastomosis. Distance of 3 to 4 centimeters. There are ulcers at the line of suture.

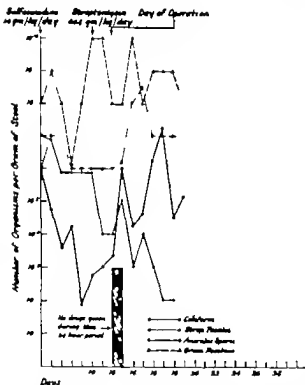


Chart 2. Sulfasuxidine, 20 gram per kilogram daily in 6 divided doses for 3 days, then 10 gram per kilogram daily of streptomycin was given orally in addition to the sulfasuxidine for 2 days, the bowel section and suture done, and the sulfasuxidine and streptomycin given postoperatively after 24 hours until the animal was sacrificed. By this dosage schedule it was hoped to have the maximum antibacterial effect at the time of operation with the most favorable conditions for healing. Healing was no better than with sulfasuxidine alone.

animals was vastly different. The control groups always showed infection and delayed healing while the process of repair in the treated groups closely resembled primary uncomplicated healing with orderly fibroplasia and revascularization (Figs. 5, 6, 7 and 8).

The gross appearance of Series B was little changed from that of Series A except for the effect of the larger inverted cuff due to the use of clamps and two rows of sutures, and for the fact that in Series B the mucosa was not as well healed and ulcerated areas were present for the first 5 days postoperatively.

DISCUSSION

The operation of bowel suture always results in contamination of the tissues which are being approximated. It is possible to avoid visible soiling but bacterial contamination of the innermost edges of the apposed bowel wall occurs during the first few minutes after the inner row of sutures is applied even though a closed aseptic technique be used. Consequently healing of the colon following anastomosis must simulate that of a contaminated wound. This fact is quite conclusively demonstrated in the microscopic sections taken across the suture line. The lessened extent to which this occurs when the bacterial flora has been simplified and attenuated by intestinal antiseptics must account for the improvement and rapidity of healing observed following the administration of sulfasuxidine (Table I).

INTESTINAL INTUBATION IN SMALL BOWEL DISTENSION AND OBSTRUCTION

Further Experiences with the Single Lumen Mercury Weighted Tube and Analysis of Complications

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The remarkable improvement which has occurred in the last decade in the treatment of bowel obstruction is due largely to three factors: (1) earlier diagnosis because of more general use of x-ray and knowledge obtained from flat film of the abdomen in suspected cases; (2) better understanding and treatment of the disturbed physiology in obstruction and (3) development in the nonoperative relief of bowel distention by intubation. Credit for the introduction of the principle of suction decompression of the intestines belongs to Robertson Ward and to Wangensteen and Paine (19). However, popularization of this method came after the development by Miller and Abbott in 1934 of the double lumen balloon tipped long intestinal tube. The surgical literature emphasizes the value of intubation as a means of treatment of obstruction and as an adjunct in minimizing distention associated with preoperative and postoperative obstruction. Beverly C. Smith, reporting on 1000 cases of intestinal obstruction in which the Miller Abbott tube was used, noted improvement in 786. Smith stated that 444 of these cases did not require operation because of lasting decompression and restoration of function provided by successful intubation. Failure to pass the pylorus was recorded in 221. Eliason and Welty in a 10 year survey of obstruction analyzed 292 cases; they found that intubation was used in 124 and eliminated the necessity for operation in 25 per cent of this group.

Utilization of intestinal intubation has been restricted because of the relative difficulty

involved in securing passage of the double lumen Miller Abbott tube through the pylorus. It was recognized that a method which provided more rapid passage of the tube was desirable. In 1941 the senior author began experimenting with liquid metallic mercury introduced into the balloon of the Miller Abbott tube to facilitate its descent. Results were so satisfactory that a preliminary report was deemed justified and appeared 3 years later (10) about the time other investigators were working independently with mercury as an aid to intubation. Wild in England presented his mechanism consisting of two tubes, a bag for inflation and an additional gravity direct or head or bag containing mercury introduced by mouth. At the time his report was published he was planning a double lumen tube. Iver Sivertsen of Minneapolis suggested to Wangensteen the use of mercury in the Miller Abbott tube but lacked clinical material to experiment with the method.

In his preliminary report in 1944 the senior author indicated that a new intestinal tube was being developed. The tube was single lumen, was weighted with a bag containing mercury and could be readily inserted through the nares into the stomach, thus simplifying the procedure of intestinal intubation. A detailed description of the tube and technique appeared in the December 1945 issue of *SURGERY, GYNECOLOGY AND OBSTETRICS*. This tube which is more easily passed and has a larger caliber to provide for adequate drainage has been a great stimulus to the increased use of intubation of the small intestine and has further confirmed the soundness of the principles of bowel decompression originally advocated by Wangensteen. Difficulties and problems associated with the

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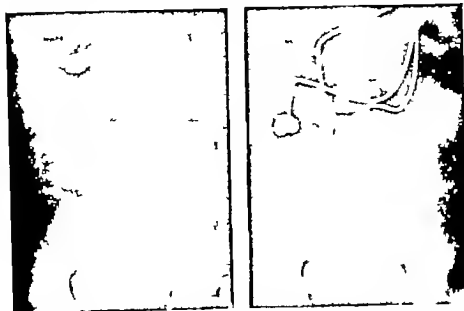


Fig. 1. a, left, X ray evidence of abnormal small bowel distention due to mechanical obstruction which developed suddenly on 15th postoperative day in 36 year old male who had had an abdominoperineal resection for perforated carcinoma of rectosigmoid. Harris tube passed too rapidly and it is coiled in stomach. Metallic clip indicates site of colostomy. b, right, Four hours later after tube had been partially withdrawn and allowed to descend spontaneously it is seen entering small bowel and there is beginning relief of distention. Obstruction relieved without operation.

1 to 2 weeks so we are ever cognizant of the possible complication of laryngeal perichondritis and resultant laryngeal stenosis. To avoid pressure necrosis it is advised that the tube be frequently withdrawn a few inches and then allowed to redescend after an interval of time as has been advocated by Holinger and Loeb.

A measured and restricted amount of liquid is allowed by mouth while the tube remains in the stomach. Until such time as the tube has passed into the small intestine we permit a maximum of 4 ounces of water tea or ice chips every 2 hours. Indiscriminate water intake during continuous gastric suction is attended by considerable danger of serious alkalosis. Water intake which is rapidly lost by the suction causes a disproportionate outpouring of salt into the stomach in an attempt to make the liquid isotonic. Withdrawal of this fluid by suction produces a fall in the chloride level of the blood and therefore the kidneys must excrete a proportionate amount of urine containing bicarbonate. Paradoxically allowance of water by mouth *ad libitum* under such circumstances becomes a dehydration measure (3).

FAILURE OF PASSAGE OF THE TUBE

There were 10 cases in which the tube failed to pass the pylorus. A brief analysis of a few of these is given to illustrate some of the minor points in technique.

CASE 1 (No 18185) A. S. female, aged 76 entered the hospital with a history of abdominal distress and fecal type vomiting during the preceding 6 hours. Harris tube passed July 4, 1946 date of entry. Twenty four hours later the tube still remained in the stomach as shown by flat film. Operation revealed mechanical obstruction due to multiple adhesions from previous laparotomy. Tube remained in the stomach for 4 days postoperatively and never passed the pylorus. Postoperative flat films showed relief from distention of the small bowel.

The Harris tube in this case decompressed the stomach. Although it did not pass the pylorus it successfully maintained intestinal decompression in a manner similar to the occasional action of a Levine tube. Failure to pass was probably due to the fact that the patient was not propped up nor was any attempt made to stand her up.

CASE 2 (No 11050) W. T. male aged 14 entered the hospital February 19, 1945 with diagnosis of perforated pelvic appendix with abscess forma-

technique of intubation are still present and we recognize that the Harris tube can and undoubtedly will be further modified and improved. Cantor (4) recently described his experiences with a modification of the tube consisting essentially of an increase in the number of perforations and a change in the placement of the mercury bag. We have had no personal experience with Cantor's modification however Arthur Allen reporting from the Massachusetts General Hospital states that the high openings in the tube are designed to pick up secretions from the stomach as well as from the intestine. It appears that the benefit of the principle of the decompression tube may be lost by this method since the normal secretions above the obstructed loop contain valuable chemical elements that are absorbed if not removed.

It is the purpose of this communication to analyze our experiences with intubation and to advocate certain changes in the structure of the tube and in technique.

COMPLICATIONS ASSOCIATED WITH PASSAGE OF THE TUBE

The method of passage of the Harris tube has been standardized and described (11). A preliminary narcotic either morphine or demerol combined with atropine is administered. A topical anesthetic such as pontocaine alleviates nasal discomfort. The tube is lubricated either with glycerine or a simple lubricating jelly. Mineral oil is never used as a lubricant because of the possibility of lipid pneumonia. The semi Fowler position is preferred. The tube is held up so that the mercury sinks to the proximal portion of the bag which is then twisted around its longitudinal axis in order to decrease its caliber. Air should be expelled from the bag before it is attached to the tube to minimize the hulk that must pass through the nose. The tip of the tube is then inserted into the anesthetized naris for half its length after which the proximal position of the bag and tube are elevated permitting the mercury to flow into the distal portion and aiding the force of gravity to drop the tube down the nasopharynx and into the stomach. After the mercury bag passes the nasopharynx it usually descends rapidly with

out provoking a gag reflex. Occasionally it descends more slowly and may be hastened by small sips of water. As soon as the tube has entered the stomach Wangensteen suction is started and maintained continuously or intermittently. Immediate suction is important as it deflates the stomach and as Wangensteen has shown often deflates the upper small intestine. Slack tubing is attached loosely to the cheek, and it is emphasized to the nursing and house staff personnel that no attempt should be made to push the tube into the intestine. If the tube has been successfully introduced into the stomach, it will pass through the pylorus and into the obstructed bowel unaided by further manipulations, or it will not pass at all. The force of gravity may be further utilized in obtaining passage by allowing the patient to stand up or walk around for a few minutes. If the patient is unable to leave the bed a high semi Fowler position with the patient on the right side is advised.

Coiling of the tube in the stomach preventing entrance into the small bowel was a complication early discovered. Coiling is the result of attempting to hurry the passage of the tube by manually feeding it into the stomach. In the original description of technique it was advised that the tube be moved along at the rate of 1 inch every 10 minutes. However we are now insistent that a 'hands off' policy be adopted and that the tube be allowed to descend spontaneously (Fig 12 and 13). Since this modification in technique has been adopted no coiling in the stomach has occurred. We now insist that progress of the tube downward be stopped at the 3 foot mark until an x ray film has been taken. The reason for this important restriction will be explained later. Attention to small details maintains the comfort of the patient and decreases minor complications such as irritation of the nasal mucosa and superficial ulceration of the naris which may lead to cellulitis. A bland ointment such as vaseline is applied frequently to the nasal mucosa and naris. Chewing gum or hard candy which may be sucked tends to prevent parotitis moistens the pharynx and aids in the prevention of laryngeal irritation. Often the tube must remain in place for from

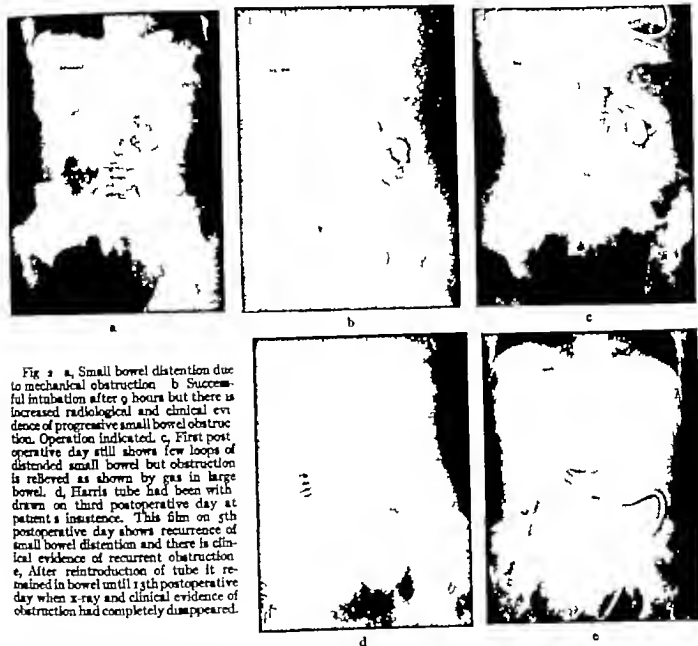


Fig 2 a, Small bowel distention due to mechanical obstruction. b Successful intubation after 9 hours but there is increased radiological and clinical evidence of progressive small bowel obstruction. Operation indicated. c, First post-operative day still shows few loops of distended small bowel but obstruction is relieved as shown by gas in large bowel. d, Harris tube had been withdrawn on third postoperative day at patient's insistence. This film on 5th postoperative day shows recurrence of small bowel distention and there is clinical evidence of recurrent obstruction. e, After reintroduction of tube it remained in bowel until 13th postoperative day when x-ray and clinical evidence of obstruction had completely disappeared.

patient and surgeon some mental anguish. It was therefore decided that the length of tubing to be passed into the small bowel should be limited to 4 feet. Another reason for decreasing the length was found when study of the numerous flat films in this series frequently showed that only 1 or 2 feet of tubing descending beyond the pylorus was sufficient to deflate completely all the loops of small bowel including those in the pelvis. It was also noted in some instances that with only 3 to 4 feet of tubing in the intestines the head occasionally would be seen at or through the ileocecal valve (Fig 3b). As the average total length of small bowel from pylorus to ileocecal valve

varies from 20 to 25 feet we must assume that the small bowel pleats itself on the tubing. This phenomenon we have compared to the principle upon which an accordion operates lengthening or shortening as it is played. This accordion principle has been verified so frequently that we have requested the manufacturer of the Harris tube to shorten it to a total length of 6 feet from its previous 9 foot length. Also we now routinely insist that after the tube has passed the 3 foot mark further progress be restricted until x ray films show its exact position. Two to 3 feet of tubing passed beyond the pylorus is sufficient successfully to decompress the entire small intestine

tion spreading peritonitis and secondary mechanical small bowel obstruction. Diagnosis was confirmed by operation performed the same day. Postoperative failure of passage of the tube was due to the fact that the patient was unco-operative and repeatedly pulled the tube out of his nose. Fortunately postoperative distention was not severe. Patient recovered.

Failure of passage was due to unco-operative patient

CASE 3 (No 17414) C. C. female, aged 53 entered the hospital with the diagnosis of carcinoma of the rectum. Abdominoperineal resection was performed May 28 1946. Harris tube was passed June 2 1946 because of abdominal distention following massive pulmonary infarction. Five days later the tube still remained in the stomach and was withdrawn. A new tube was reinserted and remained in the stomach another 3 days until June 10 1947 when it started to descend into the small bowel. It successfully decompressed loops of small bowel that appeared to be mechanically obstructed.

Failure of passage through the pylorus for so many days was thought to be due to the profound atony of the stomach associated with extreme weakness of the patient who was simultaneously suffering from massive pulmonary infarction and heart failure. We were unable to attempt to move the patient out of bed or to change her position frequently. Final recovery however was definitely aided by the ultimate relief of her small bowel distention by intubation.

CASE 4 (No 21306) J. R. male aged 40 was being treated by peritoneal irrigation according to the method of Fine, Frank and Seligman in an attempt to relieve renal failure due to sulfonamide medication. To relieve the severe small bowel distention an attempt was made to pass the Harris tube January 12 1947. It remained in the stomach until January 14, 1947 and was then withdrawn at the insistence of the patient.

Failure of passage in this case was due to unusual atony of the stomach, general weakness of the patient and inability to maintain an erect position out of bed. Patient expired.

CASE 5 (No 22941) C. K. male aged 53 entered the hospital April 18 1947 with the diagnosis of perforative appendicitis and spreading peritonitis. Operation April 18 1947 revealed generalized purulent peritonitis secondary to perforated gangrenous appendicitis. Harris tube was introduced immediately but after 4 days had failed to pass the pylorus. However postoperative small bowel distention was relieved and the tube was withdrawn.

Failure of passage cannot be explained in this case but intubation of the stomach successfully relieved the moderate postoperative small bowel distention.

DURATION OF INTUBATION

No absolute rule can be made concerning the length of time that intubation should be maintained. In this series the shortest duration was 24 hours, followed by relief in a case of a cord tumor with reflex distention. The longest was 17 days in a case of postoperative small bowel obstruction due to adhesive bands. During a prolonged period of intubation the patient's nutrition may be successfully maintained by oral intake as the decompressed loops of the upper small bowel retain their power of absorption. It has been previously emphasized that frequent flat films of the abdomen must be taken and that the duration of intubation will be determined by roentgenological as well as clinical improvement. The tube is never withdrawn until the patient has been given a fair trial without suction. If abdominal distention does not recur after periods of from 6 to 12 hours free from suction it is a good indication to remove the tube (Case 8 Fig 2d and e).

COMPLICATIONS ASSOCIATED WITH WITHDRAWAL OF THE TUBE

Early in the use of the new tube we noted an occasional case in which the head passed through the ileocecal valve. In such cases it was difficult to withdraw the tube and in one instance we are certain that the persistent attempt to pull the head back through the valve resulted in a tear of the bowel and the production of a localized abscess. It was later decided that when the bag entered the ileocecal valve the tube should be cut at the Paris and allowed to be eliminated per anus or colostomy. There have been seven such cases. No ill effects are associated with passage of the tube through the intestines except for occasional transitory abdominal colic. The time required to expel it varied in different patients; the shortest 24 hours until head of tube presented at anus; the longest (Fig 3) 10 days. This complication, while not serious is nevertheless annoying and may cause both



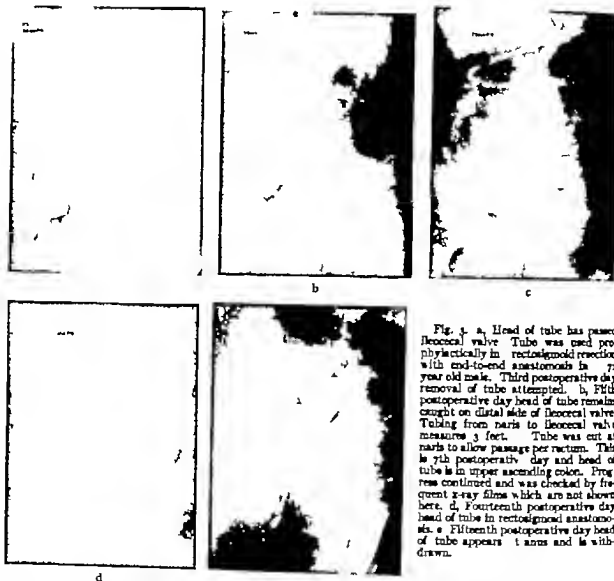


Fig. 3. a, Head of tube has passed ileocecal valve. Tube was used prophylactically in rectosigmoid resection with end-to-end anastomosis in 72 year old male. Third postoperative day removal of tube attempted. b, Fifth postoperative day head of tube remains caught on distal side of ileocecal valve. Tubing from naris to ileocecal valve measures 3 feet. Tube was cut at naris to allow passage per rectum. This is 7th postoperative day and head of tube is in upper ascending colon. Progress continued and was checked by frequent x-ray films which are not shown here. d, Fourteenth postoperative day head of tube in rectosigmoid anastomosis. e, Fifteenth postoperative day head of tube appears taut and is withdrawn.

It is not necessary for the intestinal tube actually to reach the point of obstruction in order to deflate the bowel. If the tube enters the small bowel it will act on the same principle as an operative enterostomy. Successful intubation is an 'incisionless enterostomy' which will decompress more loops of bowel more rapidly than the operative procedure. However the principle learned from operative enterostomy that a small vent in the distended bowel decompressing a local loop may deflate all the loops above or below is still applicable in intubation. It also offers another reason to explain why 2 or 3 feet of tubing in

the upper small bowel may deflate the entire intestinal tract. The shortened tube can be more easily withdrawn by mouth and the need for it to pass per rectum will be reduced.

In 3 cases the difficulty in removing the tube appeared to be due to an increase in the amount of air or gas in the rubber bag containing mercury causing unusual distention of the bag. This remarkable phenomenon is due to permeability of the rubber condom which permits an exchange of gas into the bag (13). In each case in which this complication occurred the duration of intubation had been more than 10 days. This osmotic process appears to

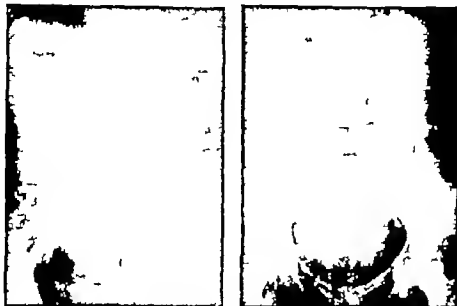


Fig 5 a, left Mercury bag broke on withdrawal of tube scattering 4 cubic centimeters of metallic mercury in small bowel. This film taken 3 hours after accident. b right Ten days later shows minute globules of mercury still present. No clinical evidence of mercury poisoning

ileus and the only treatment necessary in non occluded cases

These few quotations have been given as a small example of the apparent contradictory indications for intubation. They show the necessity of simplifying and clarifying by a change in terminology the general type of case that is best treated by intestinal decompression. Pending standardization of terminology we believe that more frequent use of the term "small bowel distention" will enable surgeons to visualize the type of patient in whom intubation is particularly indicated. Some patients suffering from medical conditions present severe distention. The problem confronting the surgeon is that of relieving distention which embarrasses circulation and respiration and which if not relieved may be an important factor leading to death. To argue whether distention represents dynamic or adynamic ileus, ileus alone, simple obstruction, mechanical obstruction, or occlusive ileus or obstruction only adds confusion and delays the proper therapeutic approach. In small bowel distention due to causes other than strangulating obstruction intubation is definitely indicated as the first treatment and is often the only treatment necessary. When intubation does not relieve distention completely after a reasonable period of time then

surgery must be considered. In primary strangulating obstructions or obstructions of the colon with great distention of the large bowel it is obvious that surgery is urgently indicated and intubation should not be used as a temporizing agent. There has been no instance in our experience in which delayed operation due to the use of intubation has resulted in a fatality. We do recognize how ever this dangerous possibility and urge most careful observation of every patient being treated by intubation instead of surgery.

A few cases are briefly summarized to illustrate the principle of primary relief of small bowel distention by intubation alone.

CASE 7 (No 21530) W L male 46 entered the hospital on medical service with the diagnosis of acute ventricular tachycardia and heart failure. Severe and embarrassing abdominal distention developed. There were no abdominal scars and it is believed that the small bowel distention was due to edema of the mesentery or wall of the bowel due to heart failure. Intubation was advised and x-ray taken 24 hours after introduction of 3 feet of Harris tube showed complete deflation of the distal loops. Total period of intubation was 6 days.

This case illustrates small bowel distention associated with heart failure and a successful therapeutic result by intubation alone.

CASE 8 (No 16410) S G female aged 42 entered the hospital March 3 1946 complaining of

had not traversed the ileocecal valve. Such a complication proved to be of diagnostic value and was an indication for surgical interference even though there was clinical and radiological evidence of deflation (Case 6)

CASE 6 (No 18836) F G female, aged 37 entered the hospital August 21, 1946, with the diagnosis of perforated appendicitis and peritonitis. Operation the same day confirmed the diagnosis of generalized spreading peritonitis. Appendectomy was performed and the wound was closed without drainage. August 24, 1946, there was radiological and clinical evidence of small bowel obstruction (Fig 4a). Harris tube was passed, August 30, 1946, small bowel distention had been relieved. An attempt to remove the tube was unsuccessful (Fig 4c) and it was decided to attempt to pass per rectum. Figure 4d shows section of the cut tube lying in the small bowel and by August 27, 1946 no further progress of the patient appeared clinically well but operative interference was indicated because of failure of cut Harris tube to move from its original position. At operation August 28, 1946, loops of small bowel were found in the terminal ileum bound down by plastic adhesions and distended. The terminal loop of ileum 1 1/4 feet proximal to the ileocecal valve was bound down in a V-shaped section. A section of Harris tube located within the terminal half of the bag in each arm of the V-shaped adhesions was performed. The bowel opened and the terminal loop inflated. Tube and bag were removed and a W type enterostomy made from the small opening in the bowel. Postoperative course was uneventful.

Inability to withdraw the tube even though it had not passed through the ileocecal valve and failure of cut section of the Harris tube to pass were important diagnostic points. We were convinced this patient had a mechanical small bowel obstruction incomplete but sufficiently severe to threaten catastrophe were it not relieved by surgical means. The osmotic swelling of the bag probably was a contributing factor in the failure of this section of tube to pass completely through the V shaped link in the terminal ileum.

BREAKAGE OF MERCURY BAG

In 4 cases the bag containing mercury ruptured during the process of removing the tube. In these careful study has been made to determine clinically and by laboratory means if there was any evidence of mercury absorption or poisoning. Urine examinations were repeatedly negative and at no time was there mercury toxicity. These findings have been

corroborated by other investigators (5) as well as by earlier experiments on dogs which the senior author performed before originally introducing the use of mercury as a vehicle for the bag of the Miller Abbott tube. The time necessary to empty the bowel of the free mercury present after rupture of the bag varied. In 1 patient (Fig 5 a and b) mercury appeared in globules in the stools for approximately 6 days at the end of which time there was very little x ray evidence of any remaining in the bowel. It has never produced diarrhea. One action of mercury frequently noted is a black discoloration of the rubber bag apparently due to chemical interaction between the rubber and the mercury. We have noted no ill effects from this phenomenon.

INDICATIONS FOR INTUBATION THERAPY

Writers on the subject of intubation have tried to define accurately the type of case in which it is of therapeutic value. Considerable confusion exists because of the wide variety of terms used to describe the particular form of obstruction suitable for such therapy. Cantor (6) states the use of the tube in postoperative ileus constitutes the type of case in which the results of intestinal intubation are most brilliant but the use of the long tube therapeutically in intestinal obstruction is exceedingly dangerous. Grimson and Hodge conclude a decompression by intestinal intubation and suction is an important therapeutic aid in the treatment of intestinal obstructions produced by multiple postoperative or inflammatory adhesions. Wangenstein (18) writes, "Trial with the method indicates that almost invariably incomplete simple adhesive obstructions whether of remote or recent origin may be satisfactorily dealt with by suction" and (suction) may be employed with advantage in a large number of obstructions of the small intestine in which the strangulating element is absent. Bockus is of the opinion that the tube finds its chief use in patients presenting adynamic ileus and those with simple mechanical obstructions particularly when this is due to adhesions and when distention has developed. Noer and Johnson have found it of value in their cases of so called occluded



Fig 5. a, left Mercury bag broke on withdrawal of tube, scattering 4 cubic centimeters of metallic mercury in small bowel. This film taken 8 hours after accident. b, right Ten days later shows minute globules of mercury still present. No clinical evidence of mercury poisoning

ileus and the only treatment necessary in non occluded cases

These few quotations have been given as a small example of the apparent contradictory indications for intubation. They show the necessity of simplifying and clarifying by a change in terminology the general type of case that is best treated by intestinal decompression. Pending standardization of terminology we believe that more frequent use of the term

small bowel distention will enable surgeons to visualize the type of patient in whom intubation is particularly indicated. Some patients suffering from medical conditions present severe distention. The problem confronting the surgeon is that of relieving distention which embarrasses circulation and respiration and which if not relieved may be an important factor leading to death. To argue whether distention represents dynamic or adynamic ileus alone, simple obstruction, mechanical obstruction or occlusive ileus or obstruction only adds confusion and delays the proper therapeutic approach. In small bowel distention due to causes other than strangulating obstruction intubation is definitely indicated as the first treatment and is often the only treatment necessary. When intubation does not relieve distention completely after a reasonable period of time then

surgery must be considered. In primary strangulating obstructions or obstructions of the colon with great distention of the large bowel it is obvious that surgery is urgently indicated and intubation should not be used as a temporizing agent. There has been no instance in our experience in which delayed operation due to the use of intubation has resulted in a fatality. We do recognize how ever this dangerous possibility and urge most careful observation of every patient being treated by intubation instead of surgery.

A few cases are briefly summarized to illustrate the principle of primary relief of small bowel distention by intubation alone.

CASE 7 (No 21530) W. L. male 46 entered the hospital on medical service with the diagnosis of acute ventricular tachycardia and heart failure. Severe and embarrassing abdominal distention developed. There were no abdominal scars and it is believed that the small bowel distention was due to edema of the mesentery or wall of the bowel due to heart failure. Intubation was advised and x ray taken 24 hours after introduction of 3 feet of Harris tube showed complete deflation of the distended loops. Total period of intubation was 6 days.

This case illustrates small bowel distention associated with heart failure and a successful therapeutic result by intubation alone.

CASE 8. (No 16410) S. G. female aged 42 entered the hospital March 3, 1946 complaining of

had not traversed the ileocecal valve. Such a complication proved to be of diagnostic value and was an indication for surgical interference even though there was clinical and radiological evidence of deflation (Case 6).

CASE 6 (No. 15536.) F G female, aged 37 entered the hospital August 11, 1946, with the diagnosis of acute perforative appendicitis and peritonitis. Operation the same day confirmed the diagnosis of generalized spreading peritonitis. Appendectomy was performed and the wound was closed without drainage. August 14, 1946, there was radiological and clinical evidence of small bowel obstruction (Fig. 4a). Harris tube was passed August 20, 1946, small bowel distention had been relieved. An attempt to remove the tube was unsuccessful (Fig. 4c) and it was decided to allow it to pass per rectum. Figure 4d shows a section of the cut tube lying in the small bowel and, by August 27, 1946, no further progress of it. Patient appeared clinically well but operative interference was indicated because of failure of cut Harris tube to move from its original position. At operation August 28, 1946, loops of small bowel were found in the pelvis bound down by plastic adhesions and dilated. The terminal loop of ileum 1½ feet proximal to the ileocecal valve was bound down in a V-shaped kink with a section of Harris tube located within the loop, one half of the bag in each arm of the V. Lysis of adhesions was performed, the bowel opened and the bag found inflated. Tube and bag were removed and a Witzel type enterostomy made from this small opening in the bowel. Postoperative course was uneventful.

Inability to withdraw the tube even though it had not passed through the ileocecal valve and failure of cut section of the Harris tube to pass were important diagnostic points. We were convinced this patient had a mechanical small bowel obstruction, incomplete but sufficiently severe to threaten catastrophe were it not relieved by surgical means. The osmotic swelling of the bag probably was a contributing factor in the failure of this section of tube to pass completely through the V-shaped kink in the terminal ileum.

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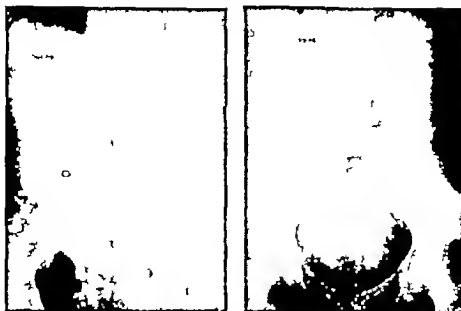


Fig 5 a, left Mercury bag broke on withdrawal of tube, scattering 4 cubic centimeters of metallic mercury in small bowel. This film taken 2 hours after accident. b right Ten days later shows minute globules of mercury still present. No clinical evidence of mercury poisoning

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CASE 8 (No 16410) S G female, aged 42 entered the hospital March 3 1946 complaining of



Fig 6 Case 9. a, Mechanical small bowel obstruction. 60 year old female due to adhesions from hysterectomy performed at age 40. b, Eighteen hours later showing only partial deflation by Harris tube. Operation indicated. c,

Six days postoperative. Film shows complete relief of small bowel obstruction and distention by combination of operative lysis and postoperative suction. Gas present in large bowel. T. to be withdrawn 4 days later.

abdominal pains for the preceding 24 hours accompanied by distention, nausea and vomiting. Cholecystectomy and hysterectomy had been performed 1 year previously. Figure 2a taken on date of admission shows distention of multiple loops of small bowel. Harris tube was passed immediately. Nine hours after introduction the head of the tube had progressed rapidly to the obstructed small bowel but recheck film showed additional loops of small bowel distention despite successful intubation (Fig 2b). Clinically the patient appeared to be worse. Abdominal pain was increasing, and it was therefore decided that operation was indicated. Operation revealed mechanical small bowel obstruction due to an exudate encircling the lower jejunum and originating from a perforating acute mesenteric adenitis. Lysis of the obstructive adhesions was performed and the immediate postoperative course was satisfactory. Three days after surgery x ray examination showed no small bowel distention and as the patient was comfortable and objecting strenuously to the tube, it was removed before the usual therapeutic test of discontinuing suction for 24 hours was instituted. Symptoms immediately recurred and roentgenogram March 8, 1946 (Fig 2d) showed recurrent obstruction as evidenced by a considerable number of loops of distended small bowel. Subsequent intubation was successful and after 9 days the final film (Fig 2e) showed no evidence of small bowel distention. The tube was withdrawn and patient's recovery was uneventful.

This case illustrates continued increase in small bowel distention and abdominal pain despite suction intubation, which was rapid

Surgery was therefore indicated and was performed because of fear of early strangulating obstruction. Inflammatory exudate from a perforated mesenteric gland part of a generalized mesenteric adenitis was the cause of obstruction. The postoperative course was complicated by recurrence of small bowel distention which was successfully treated by intubation alone.

CASE 9 (No 16557) G B female, aged 60, entered the hospital March 14, 1946 with a 3 day history of epigastric pain, nausea, vomiting, and abdominal distention. Past history revealed similar less severe attacks over many years. Hysterectomy was performed at the age of 40. Examination showed a patient obviously dehydrated presenting marked abdominal distention (Fig 6a). Harris tube was passed. X ray examination showed tube in the obstructed bowel, but clinically and radiologically there was not sufficient relief of the obstruction to warrant continued treatment by intubation alone (Fig 6b). Operation revealed multiple adhesive bands with one strong band low in the pelvis acting as a "clothes line" type of sling over which a loop of ileum was partially strangulated. Lysis of adhesions was performed. Postoperatively there was continued evidence of some small bowel distention which was successfully treated by suction intubation (Fig 6c).

This case illustrates extreme small bowel distention which was unrelieved by intubation alone. Clinical and radiological evidence in



Fig. 7 Case 10 a, Small bowel mechanical obstruction 8 days postoperative to cesarean section and sterilization b, Five days after intubation, gas is seen in large bowel and

only occasional loop of distended small bowel visible. c, Eight days after intubation was started there is complete relief of obstruction clinically and radiologically. No operation

licated continuation of small bowel distention. Clinical condition further indicated beginning strangulating obstruction making surgical interference advisable.

CASE 10 (No 21690.) M R. female aged 34 tripara, entered the hospital February 4 1947 for cesarean section. Section and sterilization procedure were performed February 4 1947. On the 8th post operative day (February 12 1947) patient developed abdominal pains and pronounced abdominal distention. X ray examination showed evidence of mechanical small bowel obstruction probably due to a postoperative adhesive band (Fig 7a). Intubation was performed on this date and clinical improvement was noted within 12 hours. Five days after the Harris tube had been introduced x ray film showed an occasional loop of distended small bowel but most of the gas was seen in the large bowel (Fig 7b). Clinically and radiologically the patient was well. On the 8th day after intubation was started (February 20 1947) final x ray examination showed complete relief of obstruction and her clinical improvement confirmed this fact (Fig 7c). Tube was withdrawn February 21 1947 after 9 days of intubation.

This case illustrates acute postoperative distention of the small bowel which responded immediately and successfully to intubation. It is useless to argue whether this abnormal small bowel distention was due to 'adynamic or dynamic ileus to mechanical obstruction or simple adhesive obstruction'. In this patient distention was due to a postoperative adhesion which mechanically partially blocked the

small bowel and produced abnormal distention. Relief of distention permitted return of normal function and normal blood supply to the small bowel and yielded a complete and satisfactory therapeutic end result.

RESULTS

In this series of 100 cases of intestinal intubation there was complete relief without surgery of the small bowel distention or obstruction in 41 cases occurring in 37 patients. Two deaths occurred in this group both were in medical cases and were not related to intubation therapy. One case was that of a patient with uncontrolled ventricular tachycardia accompanied by severe small bowel distention. The distention was relieved completely by intubation 5 days before his death from heart failure. The second case was one of renal failure due to sulfonamide medication which was being treated by peritoneal irrigation according to the method of Fine and associates. Intubation was used for the relief of the paralytic small bowel distention, and death was due to perforation of a uremic ulcer of the stomach.

In the remaining 59 cases of intubation carried out on 49 patients this therapy was used in conjunction with surgery in 13 cases preoperatively and in 46 postoperatively. Thirteen deaths occurred in this group 8 were

due to advanced metastatic peritoneal carcinoma. Four were due to peritonitis secondary to a perforated viscus and 1 to strangulating obstruction with peritonitis.

SUMMARY AND CONCLUSIONS

1 A study was made of 100 cases of intubation of the small bowel in 86 patients presenting distention or obstruction or both. Further experiences with the single lumen mercury weighted intestinal tube are reported.

2 Complications were: oiling of the tube in the stomach failing to pass the pylorus; inability to withdraw the tube; osmotic swelling of the rubber bag containing mercury; and rupture of the bag.

3 To minimize such complications changes in the technique and shortening of the long intestinal tube from 9 to 6 feet and flushing the rubber bag containing mercury with carbon dioxide are recommended.

4 The accordion principle of intestinal pleating on the tubing is described. On this basis it is recommended that only 2 to 3 feet of tubing be passed beyond the pylorus as this length is sufficient to decompress the entire small bowel.

5 Treatment of small bowel distention by successful intestinal intubation is superior to operative enterostomy.

6 The principal indication for the use of intestinal intubation as a treatment is small bowel distention associated with simple adhesion obstructions or with certain medical conditions. It should never be used as a primary treatment for strangulating obstruction of the small bowel or in obstruction of the large bowel.

7 When intubation is used to relieve small bowel distention frequent flat films and close

clinical observation are necessary in order to detect a change from simple to strangulating obstruction.

8 A statistical summary of 100 cases of intestinal intubation showed that this type of therapy was sufficient to relieve the small bowel distention or obstruction in 41 cases without recourse to surgical intervention. In 59 cases some type of operative procedure was used as a primary form of therapy.

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CHARACTERISTICS OF MIXED TUMORS OF THE PAROTID GLAND GROWING IN VITRO

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THE histogenesis of mixed tumors of salivary glands is obscure. Cohnheim was the first to advance the theory that they were essentially epithelial. Several investigators have supported this concept (2, 5, 8, 9). They hold that the cartilage often present represents a change in epithelial components. Others believe that mixed tumors arise from pluripotent embryonal cells displaced during the course of development (4, 7, 10).

Murray has shown that neoplastic cells growing in vitro may evince some of the specialized characteristics of the normal cells from which they arise. Comparison of tissue cultures of parotid mixed tumors with cultures of duct cells from fetal parotid gland indicates that both grow in essentially the same patterns. This suggests that mixed tumors may be derived from cells lining the ducts of salivary glands.

Five sterile mixed tumors of the parotid gland were obtained at operation. The histological appearance of these neoplasms was almost identical. They were composed of clumps of small epithelial cells some of which formed small acini. The cell groups were separated from one another by masses of hyalin appearing faintly basophilic matrix in which were imbedded isolated cells larger than those seen in the epithelial clumps. This material appeared to be cartilage. All of the specimens also contained large quantities of edematous tissue rich in fibrils and stellate cells. The tissues cultured came from the immediate proximity of the sites from which blocks were taken for histological examination.

The method by which the tissues were grown in vitro involved the use of purified human fibrinogen and bovine thrombin. It

has been described previously in detail (6). The growing tissues were studied daily. Explants were made at appropriate intervals. Some cultures were fixed in Schaudinn's fluid and stained with hematoxylin and eosin.

The cultural characteristics of each of the five tumors were similar.

Only a few small macrophages migrated from the explants during the first week of their growth. Then long thin, spindle shaped cells with elongated nuclei and fine terminal processes appeared (Fig. 1). Their ends overlapped to form long strands. These cells, presumably fibroblasts, delineated other groups of cells or radiated from the periphery of the cultures. They were conspicuous only during the early period of growth and later became masked by the more actively proliferating epithelium.

Little isolated clumps of closely packed small ovoid cells with basophilic cytoplasm were seen near the periphery of the growing masses. Their cytoplasm became acidophilic and developed short irregular processes. These cells disappeared during the third week of growth despite vigorous mitotic activity. They were probably macrophages and resembled those that migrated early in the course of the cultures growth.

At the same time fibroblasts were first noted clumps of large rounded almost cuboidal cells with finely granular basophilic cytoplasm and centrally placed ovoid nuclei appeared. These large cells formed long cords and acini enclosing round spaces (Fig. 2). Later they grew in broad sheets in which the cells were evenly spaced giving the growth a mosaic pattern (Figs. 3 and 4). The cells at the growing edges of these sheets continued to form cords and acini. Some cells appeared distinctly columnar.

The large epithelial sheets gradually developed focal areas in which the cells had acidophilic cytoplasm appeared smaller and

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Fig. 2. Thirteen day culture of a mixed tumor of the parotid. The transplant is seen as a black mass. Rounded epithelial cells form cords and enclose spaces. $\times 70$

were packed together more closely (Fig. 3). Cells intervening between the focal areas appeared to spread out their cytoplasm so that nuclei came to lie farther apart. Fine intercellular bridges could be detected. This pat-



Fig. 3. Seven day culture of mixed tumor of the parotid gland. Epithelial cells form an annulus. $\times 385$



Fig. 5. Twenty three day culture of mixed tumor of the parotid gland containing large sheet of epithelial cells. $\times 70$.

tern was fully developed in cultures 60 days old.

During the next 30 days spaces appeared in the centers of some of the condensed foci (Fig. 6). The cells in these areas became smaller and

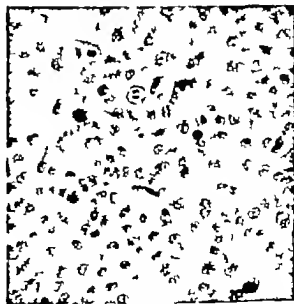


Fig. 4. Twenty-three day culture of mixed tumor of the parotid gland. A higher magnification of Figure 5. $\times 375$



Fig 5 Fifty-one day culture of a mixed tumor of the parotid gland. The transplant is seen as a dark mass. The cells have grown out as a uniform sheet one cell thick. There is a clear space between cells and there are areas where the cytoplasm is very thin. Darker acidophilic cells are distributed in clumps. $\times 70$



Fig 6 Eighty-three day culture of a mixed tumor of the parotid gland. The cells are beginning to degenerate and form clear spaces. Many clumps of acidophilic cells are seen which are small and oval to cuboidal in shape. $\times 70$

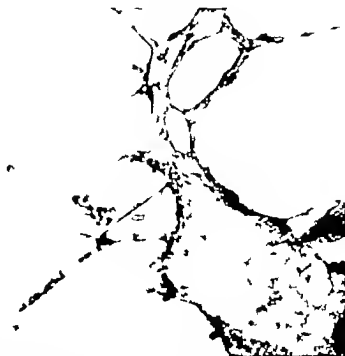


Fig 7 Eleven day culture of the parotid gland from a 4 month old human fetus. The transplant is seen as a dark mass from which a sheet of epithelial cells extend. $\times 70$

their cytoplasm appeared more acidophilic. Large vacuoles developed in the intervening cells. Some of these cells disappeared leaving



Fig 8 Eleven day culture of tissue from the parotid gland of a 4 month old fetus. Note the presence of large intracytoplasmic vacuoles and the cord formation. $\times 375$

irregular spaces. Most of the cultures died within 140 days of the time they were started. Regressive changes dominated the picture during the last 6 weeks.

Tissue from the parotid gland of a 4 month old human fetus delivered by hysterotomy was grown in vitro using the same techniques. This tissue contained only ducts and no recognizable acinar components which develop during the fifth month of intrauterine life. The potentialities for the formation of acinar cells by this tissue are present. However it seems highly improbable that the stimuli afforded by tissue culture can evoke them. Differentiation is distinctly uncommon among most cells growing in vitro. It seems reasonable to assume that the epithelial elements contained in these explants of fetal parotid gland were derived solely from ducts.

Sheets of large rounded almost cuboidal cells with pale cytoplasm and centrally placed large round or ovoid nuclei were seen in cultures only 12 days old (Fig 7). Some of these cells were grouped about spaces. Others formed cords. Condensed foci of smaller acidophilic cells appeared. Large cytoplasmic vacuoles formed (Fig 8). Clear areas developed in the cell sheets. The development of these explants resembled closely that of the cultures made from mixed tumors. The embryonal cells grew less vigorously than the tumor cells. The total mass of cells formed by fetal parotid explants never approached that of explants derived from the mixed tumors. Good growth lasted for only 37 days as contrasted with the 90 days of progressive growth of the neoplastic cells.

This study suggests that the pleomorphism that characterizes mixed tumors of salivary glands may result from secondary changes in a neoplasm composed almost exclusively of epithelium. The solution of cells in actively

growing sheets may be due either to hypersecretory activity or more probably to some pathological mechanism resulting from adverse environmental circumstances. The culture is bathed in a fluid which may remove the products of cell disintegration but the growing tumor with its relatively poor blood supply to its interior must store these products as a gel which contains some viable appearing cells. The end result would approximate closely the appearance of cartilage or myxomatous tissue. It has long been known that these elements in mixed tumors of salivary glands do not provide the usual tinctorial reactions of cartilage or myxomatous tissue of unquestioned mesenchymal origin (12).

While these observations support those who adhere to the epithelial nature of mixed tumors they do not form any basis for discriminating between the embryonal or adult nature of the cell of origin. Mixed tumors comparable to those found in man have not yet been produced in lower animals. However as cancer research progresses, the argument that misplaced embryonal cells give rise to neoplasms becomes progressively more tenuous.

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THE USE OF POLYTHENE FILM AS A DURAL SUBSTITUTE

An Experimental and Clinical Study

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INVESTIGATORS have long sought an adequate and practical substitute for the dura mater when replacement of this membrane is necessary by reason of injury or disease. An imposing list of materials has been subjected to experimental and clinical tests and then rejected as unsuitable or used with reluctance in the absence of a more satisfactory substance. At different times in the past the following groups of materials have been employed with variable success: (1) the metallic foils—gold, silver, platinum and more recently tantalum; (2) autoplasmic membrane—fascia lata, peritoneum, peritoneum and fat; (3) nonviable membrane—amniotic membrane, allantoic membrane and Carle membrane; (4) a group of miscellaneous materials including celluloid, cellophane, fibrin film, and rubber tissue. All but a few of the foregoing substances have been discarded entirely; the field of usefulness of the remainder has been so restricted by their inability to meet many of the criteria of a dural substitute that the search has still continued. In a previous communication (1) we presented a preliminary report on polythene film as a dural substitute; this paper is intended to complete in greater detail our present experimental and clinicopathologic knowledge of this material. Necessarily much still remains unsaid on this latest addition to plastics in surgery.

There is general agreement that dural substitutes should possess certain basic criteria as follows: (1) inertness in cerebral tissue; (2) nontoxicity; (3) nonresorbability; (4) high tensile strength; (5) elasticity; (6) suturability; (7) nonadherence to leptomeninges and cortex. It is implied in criteria 1 and 2 that the mate-

rial be nonpileptogenic and noncarcinogenic. In addition to these basic criteria it is advantageous for the substance to be available in free supply, relatively inexpensive and easily sterilized. The different criteria listed are necessary in different surgical situations and compound the problem of a substitute material beyond the mere repair of dura. In the case of cerebrospinal rhinorrhea or of an open ventricle following resection of a lobe the emphasis falls on tensile strength and suturability in order to construct a watertight dam. Nonadherence is the primary requisite of a dural substitute in cases of penetrating cranio-cerebral injuries. In the group of malignant gliomas resection is usually subtotal and recurrence may be anticipated; in this situation a dural substitute possessing some degree of elasticity would be desirable for purposes of decompression. All of these qualities are therefore desirable under the special conditions which are encountered in the everyday practice of neurologic surgery.

REVIEW OF OTHER SUBSTITUTE MATERIALS

The substitute materials which have attracted the most attention during the recent war period are animal membrane, tantalum foil and fibrin film. The remainder have been almost entirely discarded aside from the occasional use of fibroplastic substances such as fascia. In an extensive study of numerous viable and nonviable materials by Pudenz and Odom it was found that tantalum foil was far more effective than any of the animal membranes or polyvinyl alcohol from the standpoint of preventing meningocerebral adhesion. The various materials were placed in the subdural space of cats for periods up to 240 days; all were found to be encapsulated in varying degree. These authors found that the different animal membranes were resorbed and fu-

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mon of the two layers of the capsule then occurred. There was an eventual inflammatory reaction binding brain and dura that was probably greater than if the animal membranes had not been used. The extent of adhesion varied somewhat with the degree of wrinkling and folding of the membrane. In our experience this is almost invariably the case when the material is employed at the operating table. The authors concluded that the use of animal membrane for the prevention of meningocerebral adhesions was no longer warranted. Other major drawbacks to the use of membrane particularly its low tensile strength and lack of suturability are well known.

Pudenz and Odom found that tantalum foil on the other hand, provoked only minimal reaction and there was but slight adhesion at the margins of the neomembrane. Delarue, Linell, and McKenzie placed tantalum foil under the dura of 12 dogs and described serious reactive thickening of the dura and arachnoid which they felt contraindicated its use. Robertson and Peacher however were unable to confirm this finding in a variety of clinical cases in which they used foil to prevent adhesion. They felt that it was of definite value for this purpose. These authors noted 2 cases in which crepitus developed postoperatively and they had some difficulty with wrinkling and folding of the foil. Sachs recently has warned against the use of foil as a dural substitute because of crepitus. Thin tantalum rattles with the slightest movement like a dry leaf in the wind thus noise recurring with every cerebral pulsation becomes extremely annoying to the patient. Sachs noted several instances in which the material had to be removed. The present status of tantalum foil may be summarized by stating its advantages to include inertness in tissue and nonadherence and its disadvantages to be the occurrence of crepitus, opacity to roentgen rays, low tear resistance and lack of suturability.

The major clinical and experimental investigations into the use of fibrin film as a dural substitute were carried out by Ingraham and Bailey and Ingraham, Bailey and Cobb. They established the fact that fibrin film is gradually absorbed and replaced by a neomembrane with minimal reaction of the surround-

ing tissues. In addition there was good evidence that the film was valuable in minimizing meningocerebral cicatrix. Ferry and Morrison and Morrison and Singer have studied the mechanical properties of fibrin films and their resorption rates in tissues. They emphasized the variation in tensile strength, elasticity and resorption time in films that differed in the proportions of fibrin and plasticizer. In rabbits the persistence time of fibrin film treated with a high proportion of plasticizer extended to more than 80 days whereas the purest fibrin product began to disintegrate as early as 5 days after implantation. Loss of tensile strength and elasticity was characteristic of the older films. In general therefore fibrin film may be appraised as unequivocally harmless when in contact with cerebral tissue, and of value in reducing traction on the brain by the extracerebral tissues. The film has drawbacks however that militate against its use as an all round dural substitute: difficult and highly expensive preparation and resorbability which is too rapid in the purest, and consequently most desirable film for purposes of repair and replacement of dura. Moreover it is deficient in suturability with a tensile strength that is not sufficient to maintain a watertight closure against pressure.

Thus the status of dural substitutes up to the present time has been that the necessity for repair entailed the use of materials that were either fibroplastic, laborious to prepare and handle or possessed properties that were not suited to meet the problem at hand. When polythene film became commercially available in quantity and appeared to have the desired physical qualities for a dural substitute experimental and clinical tests were carried out to determine its suitability.

PROPERTIES OF POLYTHENE

Polythene (polyethylene med-o-seal) is a synthetic, thermoplastic resin produced by the polymerizing of ethylene under conditions of high pressure and elevated temperature. The simplest chain polymer that can exist is formed—a belt of carbon atoms each one carrying two atoms of hydrogen to an approximate molecular weight of 18,000. By varying the molecular weight and the thickness of the

material, flexibility of this paraffinic hydrocarbon can be altered without the addition of objectionable plasticizers. Pure polythene may be injection molded into any thickness of film or size of tubing that is desired for the particular surgical use at hand.

Polythene is remarkable by virtue of its extreme chemical inertness. It is not substantially affected at room temperature by concentrated hydrochloric, sulfuric or even by hydrofluoric acid and resists concentrated sodium hydroxide. The plastic is insoluble in tissue fluids, extremely resistant to moisture and oxidation and has the anticoagulant property that characterizes paraffinic products when they are brought into contact with blood. The film employed as a dural substitute in these investigations is a waxy white translucent material tasteless and odorless 0.002 inch (0.005 cm) in thickness. Recently film of a thickness of 0.001 inch (0.0025 cm) has been obtained for clinical use. The film has great tensile strength and resistance to tearing permitting easy firm suturing. It is sufficiently elastic to allow an elongation up to 60 per cent when subjected to a stress of 1,200 to 1,400 pounds per square inch. Above this tension the cold-drawing phenomenon occurs which permits a further increase in tensile strength to as high as 25,000 pounds per square inch with some irreversible elongation of the material. Increase of temperature above 50 degrees C (122 degrees F) increases the flexibility of the specimen; the critical temperature is 115 degrees C (239 degrees F) above which polythene exists as an amorphous liquid. Throughout the range of body temperature variations the plastic has constant physical properties. Polythene film is not opaque to roentgen rays. The material will tolerate boiling but not autoclaving. We have found that cold sterilization according to the following method is the simplest way of preparing the film for surgical use: a soap and water wash immersion in 1:1,000 solution of merthiolate for 30 minutes followed by a rinse in isotonic saline solution.

From the standpoint of advantageous physical properties polythene film appeared to be suitable for a trial as artificial dura. While this work was in progress Ingraham, Alex-

ander and Matson in a review of plastic materials in surgery, referred to their unpublished studies in which polythene tubing was buried in the cerebral hemispheres of animals. A thin fibrous neomembrane formed about the tubing with no evidence of any irritative effects. Apart from this work no reference to the use of polythene in experimental neurosurgery exists to our knowledge.

EXPERIMENTAL STUDIES WITH POLYTHENE

Ten animals (8 dogs and 2 monkeys) were employed in the experimental study with polythene film and tubing. All operations were carried out with the animals under intra-tracheal ether anesthesia, sterile technique being used. In 7 animals large osteoplastic bone flaps were fashioned and a comparable area of dura was excised and replaced with polythene film. In addition in 2 of these animals the underlying cortex was lacerated, producing specific neurologic defects. In the 3 remaining animals polythene tubes were inserted into the lateral ventricle to form an artificial fistula between this cavity and the subarachnoid space. The brains of 8 animals have been re-examined at intervals of 2, 4, and 6 months; the others are being observed in definitely for possible late deleterious effects. The 10 animals used in the series all survived primary craniotomy. At the time of re-examination there were 2 postoperative deaths: one animal expired 2½ months after ventriculostomy and 4 animals were employed to obtain complete histologic studies. Wound healing was normal in all instances and there were no abnormal neurologic effects attributable to the polythene film or tubing. In the 2 instances in which the cortex was lacerated beneath the film, recovery of sensory motor function proceeded at the anticipated rate. The 3 ventriculostomy tubes have been re-examined and found to be patent, unchanged in appearance and containing spinal fluid. In 1 instance interventricular bleeding had occurred when the ventriculostomy tube was inserted, blocking the aqueduct of Sylvius; the tube effectively by-passed the block for 6 months and when it was removed the animal expired rapidly of acute obstructive hydrocephalus.



Fig. 1. Frontal section of brain of dog 5, 16 months. The dotted line indicates the position of the polythene film which is present. Neomembrane blends imperceptibly into normal dura.

Examination of the film at the time of reoperation or killing of the animal showed that it was identical with the material in its normal state. In all cases when the bone flap was uncovered the film was entirely nonadherent to the underlying leptomeninges and cerebral cortex. Grossly and histologically a thin sub-

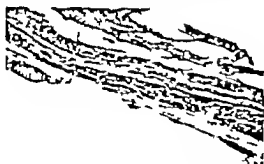


Fig. 2. Neomembrane, leptomeninges, and cortex of brain of dog 5, 16 months. There is a striking absence of reaction to the presence of polythene film. $\times 48$.



Fig. 3. Frontal section of brain of dog 5, 14 months. The dotted line indicates the position of the polythene film, and the arrow shows the edge of a small cortical laceration in the superior parietal lobule.

dural neomembrane forms between the film and the arachnoid. Actually this neomembrane is a regeneration of the inner layer of the dura mater from the margins of the defect into the dead space. The collagenous fibrils of the newly formed dura are oriented in a direction that parallels the film. This neomembrane is likewise nonadherent and may be easily dissected off the underlying arachnoid in both the wounded and unwounded animals. There does not appear to be any tendency to meningeocerebral adhesion. Histologic sections have failed to reveal any foreign body giant cells or evidence of reaction in the pia arachnoid and cortex. Figures 1 through 6 illustrate these characteristic pathologic features.

CLINICAL APPLICATIONS OF POLYTHENE FILM

After completion of the laboratory observations a clinical study of polythene film was carried out on 20 patients. Although the number of cases is insufficient to draw other than tentative conclusions the results have been promising and have paralleled closely what one would anticipate from the experimental findings. In 8 patients there was extensive neoplastic invasion of the dura necessitating its sacrifice and replacement. 7 of these patients had large meningiomas and the eighth a fibrosarcoma involving brain dura, bone and temporal muscle. The film was likewise employed to repair the dural defect in cases of cerebrospinal rhinorrhea. In these cases clos-



Fig. 4. Neomembrane, and lacerated left meninges and cortex of brain of dog 5 at 4 months. The fibrils of the regenerated dura are oriented in a position which is parallel to the surface of the brain without adhesion to the wound. $\times 38$

ure may be effected by the use of polythene film without the tension which so frequently exists even when extensive mobilization of the dura has been carried out. After the film has been pinned at the margins a continuous suture should be employed about the circumference of the defect to insure watertight closure. It is possible that the use of polythene will allow these patients to be uniformly managed by the unilateral transfrontal approach thus avoiding the complete anosmia that is a sequela to the bilateral operation.

Apart from the primary purpose of polythene film in repair and replacement of dura subsidiary uses of considerable importance in neurologic surgery follow the logical application of its various properties. We have employed the film in the prevention of adhesion between the brain and the extracerebral structures in lobotomy. When the dura is split to permit insertion of a cutting instrument under direct vision in lobotomy there is usually considerable difficulty in the repair of this membrane. To avoid having the bone button rest directly on the cortex film may be quickly inserted as an interposition membrane. The prevention of cicatrix formation in penetrating head injuries is advanced only as a tentative application in lieu of sufficient personal experience; the experimental findings would indicate that polythene has interesting possibilities in this respect.



Fig. 5. Postmortem photograph of polythene film overlying a large lacerated wound in the motor and premotor areas. The regenerated dura has been turned back to illustrate the translucence and nonadherence of the film after 6 months *in situ*. Monkey 2.

The remaining clinical applications require no additional comment excepting the use of film in arresting bleeding by tamponade. When severe hemorrhage from a venous sinus and inaccessible vessel or a tumor bed can be controlled only with gauze packing a strip of film is interposed between the hemostatic agent (muscle fibrin foam or gelfoam) and the pack. The pack may be removed early in the postoperative period without fear of dis-

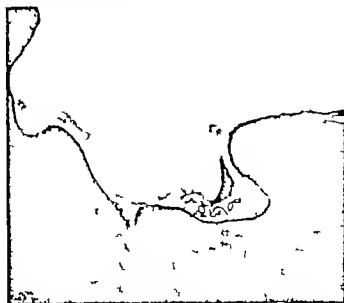


Fig. 6. Base of a large cortical laceration brain of monkey 2 at six months. The remaining cerebral debris is undergoing phagocytosis by glial cells; the cavity otherwise shows little reaction and a new limiting membrane has formed. $\times 13$

turbing the clot that has sealed off this bleeding point

Polythene is similar to silk nylon tantalum and other nonresorbable materials in that removal of the film is probably indicated if infection becomes established in a wound. Emphasis on strict aseptic precautions at the time of operation and in postoperative dressings is therefore essential. We have removed the film together with infected bone and bone wax in 2 cases of chronic sepsis. These cases illustrate points which are worthy of some discussion. In the first patient a *Micrococcus catarrhalis* infection followed transfrontal craniotomy. Removal of the film covering the anterior burr hole did not cause subsidence of the drainage; the bone was devitalized and eventually the flap was sacrificed whereupon drainage ceased. The second case was that of a large parasagittal meningioma in which a gauze pack was left in place for 7 days to control hemorrhage from a large communicating vein; in addition it was necessary to reoperate for a postoperative clot at which time the bleeding points in the bone flap required extensive coagulation and waxing. When the packing was removed infection developed in the tract and the bone flap became devitalized. Ten weeks after resection of the tumor the bone flap was removed and a large extradural abscess was evacuated. It was of interest to note that despite the degree of infection in this case the film was unchanged in appearance and physical properties, and was entirely nonadherent on removal. Dural regeneration was complete beneath the film and had effectively walled off the infection. It is likely that if no film or if a resorbable membrane had been used formation of an intracerebral abscess would have resulted. In the remaining

18 cases wound healing was normal and there have been no late complications in periods up to one year. There has been no single instance in the experimental or clinical series in which polythene film was responsible for drainage in a clean wound with an adequate blood supply.

SUMMARY

1. An experimental study of polythene film has shown that it fulfills the criteria of a dural substitute.
2. Polythene film does not adhere to the underlying leptomeninges and cerebral cortex. This property permits the dura to regenerate between the film and the arachnoid. Histologic studies indicate that there is no reaction in the pia arachnoid and cortex to the presence of the film.
3. A clinical trial of polythene film has shown that it is a satisfactory dural substitute and suggests other important uses of polythene in neurologic surgery.

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EFFECTS OF ABSORBABLE FOREIGN SUBSTANCE ON BOWEL ANASTOMOSIS

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ABSORBABLE hemostatic materials represent a great advance in surgical hemostasis under certain emergent conditions. In addition to their ability to control most hemorrhages when properly used, these substances are absorbed with minimal reaction by most tissues. Frantz (4) has shown that in general oxidized cellulose does not delay healing of soft tissues. In clean bone surgery, however, its presence may slightly delay callus formation (7). Burns has demonstrated the pattern of absorption of oxidized cellulose from the uncontaminated peritoneal cavity. The substance is absorbed by phagocytosis with no ill effects. Jenkins and his group (5, 6) have pointed out that in the presence of contamination or infection in areas other than the peritoneum, the absorbable gelatin sponge may offer a culture medium which may influence the development and propagation of infection. It is not known to what extent absorbable hemostatic substances can be used safely in the peritoneal cavity when open surgery on the bowel is performed. The limitations of their use will depend to a great extent, on how they influence the spread of peritonitis and what effect they will have on the integrity of anastomoses and other sutured areas in the intestine.

Devine has shown that strips of peritoneum or skin applied about a bowel anastomosis will usually prevent peritoneal soiling from an otherwise inadequate suture line. While planning our experiments, the thought occurred to us that perhaps the absorbable hemostatic substances might also serve as sealing agents by virtue of their hemostatic qualities.

The purpose of our experiments then was to determine the limitations and extent of usefulness of the absorbable hemostatic substances

in intestinal surgery. Both the gelatin sponge and oxidized cellulose were used. We wished to determine whether the surgeon is justified in leaving such foreign substances in the peritoneal cavity after dealing with open bowel

EXPERIMENTAL PROCEDURES

In a group of preliminary procedures a strip of gelatin sponge was attached about an anastomosis of the upper ileum in which through and through sutures were used. All these dogs recovered without any ill effects. However, anastomoses in this area of the dog's intestine are known to heal without much difficulty almost regardless of technique used. We decided therefore to conduct a controlled experiment with anastomoses of the descending colon.

Ordinary mongrel dogs were starved for 24 hours prior to surgery, but were otherwise unprepared preoperatively. Intravenous nembutal anesthesia was used. Through a midline incision the colon was brought up and walled off with pads. A portion of the descending colon was kneaded free of its contents and cut across between rubber-tipped clamps. The field was walled off with sponges and open ends of bowel were carefully cleansed of fecal matter with gauze pellets. Instruments were discarded as they became contaminated. The standardized technique of anastomosis consisted in using only 8 interrupted inverting mattress stitches of fine silk through all layers. In the control group this was all that was done, and the abdomen was closed. This procedure carried with it a certain amount of risk, since the silk in traversing all the layers carried contamination to the serosal surface.

In a second group the ends of four alternate stitches were left long and a strip of gelatin sponge was applied around the bowel over the anastomotic line and tied in place by securing these ends (Fig. 1). In a third group the same procedure was done using a strip of oxidized cellulose. 2 brands of cellulose were used

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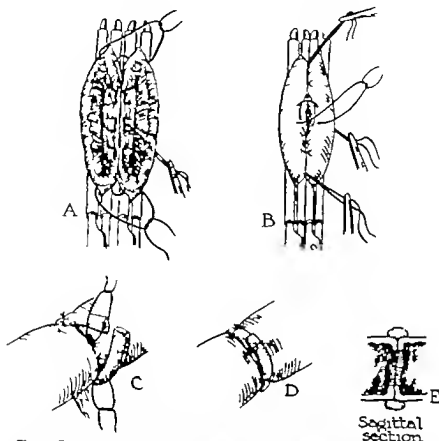


Fig Technique of performing experimental open anastomosis of descending colon in unprepared dogs by 8 inverting interrupted mattress sutures of silk. Figures C, D and E show method of applying absorbable hemostatic substance around anastomotic line.

RESULTS

In a group of 8 control animals, 6 had successful anastomoses with no ill effects. One animal died 10 days postoperatively and at postmortem was found to have a small localized abscess in the vicinity of the anastomosis and milary abscesses in the lungs. There was no generalized peritonitis. One animal died 5 days postoperatively following a small disruption in the anastomosis and a localized peritonitis. The 6 surviving animals were sacrificed at various periods postoperatively ranging from 12 to 43 days. Except for the adherence of the omentum to a portion of the anastomosis there was no evidence of severe peritoneal infection (Figs. 2 and 3).

In 5 dogs gelatin sponge was placed about the anastomosis and held in position by the technique described. Of these dogs, 4 died 4 to 11 days postoperatively of a fulminating

peritonitis, and the anastomosis was found disrupted in each instance (Figs. 4 and 5). The remaining dog was explored 12 days postoperatively. The degree of adhesion formation about the anastomosis served as evidence of a severe, but healed peritonitis.

In 8 dogs a strip of oxidized cellulose was applied about the anastomosis in the manner described. Of these, 5 died 3 to 4 days postoperatively with disrupted anastomoses and generalized peritonitis (Fig. 6). Two of the remaining dogs in this series were explored on the fourteenth postoperative day after a severe postoperative course. In both instances the abdomen was found to contain a great deal of clear fluid, and the omentum and neighboring intestinal loops were plastered against the anastomosis. This was evidence of healing severe peritonitis. One dog in this series survived with no apparent ill effects and, when



Fig 2.

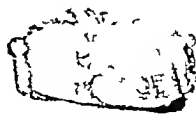


Fig 3.



Fig 4



Fig 5.



Fig 6

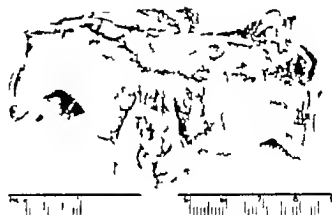


Fig 7

Fig 2. Dog 20 control group. Specimen of anastomosis of descending colon 12 days after operation. Successful result. Small tag of omentum adherent to suture line.

Fig 3. Dog 19, control group. Specimen of anastomosis of descending colon 30 days after operation. No foreign substance used. Successful result in 6 of 8 attempts. Note minimal peritoneal reaction.

Fig 4. Dog 2, gelatin sponge group. Disruption of anastomotic line as seen at death 4 days after operation. Note portion of gelatin sponge still visible at upper angle of disruption.

Fig 5. Dog 4, gelatin sponge group. Specimen of anastomosis of descending colon at death 5 days after operation, showing disruption of anastomotic line.

Fig 6. Dog 12 oxidized cellulose group. Disruption of anastomotic line as seen at death 4 days following the operation. Specimen cut open. Arrow points to site of disruption.

Fig 7. Dog 22 oxidized cellulose group. Specimen of anastomosis of descending colon 14 days after operation showing severe peritoneal reaction and adhesion formation about anastomotic line despite successful result.

explored on the fourteenth postoperative day was found to have a clean abdomen except that the omentum was bound down to the entire circumference of the anastomosis (Fig 7).

In 4 dogs a second brand of oxidized cellulose was used. All died 3 days later from disruption of the anastomosis and peritonitis.

In summary 6 of 8 unprepared dogs in which open anastomosis of the descending colon was performed survived with no ill effects. Of 17 dogs in which an absorbable hemostatic substance was applied about the anastomosis (5 gelatin sponge 12 oxidized cellulose) 13 died of disruption of the anastomosis and peri-

remove these materials before closing the peritoneum or resort to other means of hemostasis.

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TOXEMIA SUPERIMPOSED UPON PREPREGNANT HYPERTENSION TREATED BY SPLANCHNICECTOMY

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IT is generally recognized that the occurrence of pregnancy in a female who already has an established hypertension presents a complication with serious potentialities. In the first place 50 per cent of prepregnant hypertensives can be expected to develop a superimposed toxemia according to Dexter and Weiss. Secondly approximately one-quarter of these patients are left with higher blood pressure levels and more extensive disease as a result of a toxemic pregnancy. Thirdly the fetal mortality is greater in females with pre-existing essential hypertension (21 per cent in the series of Dieckmann and Brown). Furthermore organs weakened by pre-existing hypertensive disease are more susceptible to stress induced by toxemia than are healthy organs and therefore a greater incidence of cardiac failure renal insufficiency and cerebral accidents can be anticipated.

For these reasons many observers of this problem consider hypertensive cardiovascular disease a strong indication for the interruption of pregnancy. Certainly conservatism is warranted in any advice offered the hypertensive female who is desirous of a pregnancy yet she need not be completely discouraged from any attempt at childbearing provided she understands the potentialities and will cooperate in a cautious supervision of the pregnancy by her obstetrician.

Half of these hypertensive females are capable of going through a pregnancy without any aggravation of their hypertensive state. As for the other half close surveillance should enable prompt recognition of the development of toxemia. The pregnancy may be terminated should the toxemia persist. However another alternative is available and is herewith presented.

A new therapeutic approach to the problem of toxemia superimposed on prepregnant hypertension has been tried at the University Hospital during the past 5 years. Bilateral supradiaphragmatic splanchnicectomy with lower dorsal sympathetic ganglionectomy has been performed in 5 such cases. This surgical treatment is aimed directly at the underlying hypertensive disease for it is believed that the complicating toxemia is a consequence of the pre-existing hypertensive state.

In 2 of the patients so treated the results have been brilliant, following operation in both the toxemia disappeared normal blood pressure levels were achieved living infants were obtained and normal blood pressures have persisted for 4 years and 2 years respectively since delivery. In the remaining 3 cases the operation exerted no influence on the toxemia but in 2 of the cases the blood pressure levels following delivery have been significantly decreased as compared to the prepregnant level. In the fifth case splanchnicectomy in no way deterred the hypertensive

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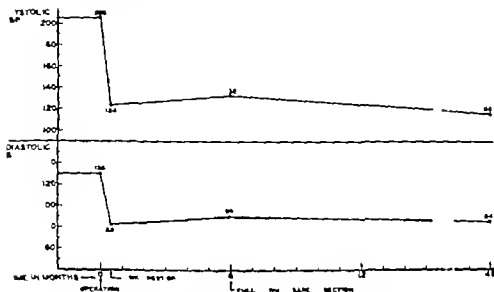


Fig. 1. Case 1 followed 4 years after splanchnicectomy

disease from pursuing a progressive and fatal course 14 months after miscarriage

CASE REPORTS

CASE 1. M P, age 31 years, secundigravida, was admitted on January 17, 1943, with the history that she had been refused life insurance at the age of 30 because of elevated blood pressure. During the prior 3 years she had noted progressive increase in severity of occipital headaches, fatigability and nervousness. She had moderate exertional dyspnea. One year previously she had completed her first pregnancy giving birth to a normal male infant. During this pregnancy she had albuminuria, and her blood pressure was in the range of 180 systolic and 110 diastolic; these levels persisted postpartum.

Her last menstrual flow began on September 6, 1942, and she was starting the second trimester of her second pregnancy. During the previous 3 weeks her headaches had become incapacitatingly severe, and her blood pressure had risen to an average of 205 systolic and 130 diastolic. Fundus examination revealed a grade III hypertensive retinitis with the arterioles showing generalized attenuation, localized angiospasm, arteriovenous notching, and increase in reflex stripe; there were several small granular hemorrhages and several cotton-wool patches. Both lung fields were clear. The heart was slightly enlarged, but otherwise not abnormal. The uterine fundus was felt above the symphysis pubis. There was no peripheral edema. Examination revealed a uterus compatible with a 4 months pregnancy.

The electrocardiogram was normal. The teleroentgenogram revealed slight cardiac enlargement, with the measurements for area and transverse diameter respectively giving variation values of +33 per cent and +6 per cent greater than predicted

normal. Retrograde cystograms were negative. The urea clearance averaged 71 per cent of normal. Maximum urine concentration on an 18 hour test was 1,017. Blood nonprotein nitrogen was 29.8 milligrams per cent. Urinalysis revealed 2+ albuminuria, and was normal otherwise.

Bilateral supradiaphragmatic splanchnicectomy with lower dorsal sympathetic ganglionectomy (9th through 12th dorsal) was performed on January 21, 1943. The postoperative course was entirely uneventful, and she was discharged on the 14th day with a blood pressure of 124/82.

She returned to the care of her obstetrician in Lawrence, Kansas, and for the remainder of her pregnancy her blood pressure remained within normal limits; the highest level reached was 132/90 shortly before delivery. The albuminuria persisted, but she was completely relieved of her severe headaches. On June 14, 1943, she was delivered of a full term normal infant by cesarean section.

Examination on August 11, 1947, four and one-half years after operation, found her in good health. Repeated blood pressure determinations averaged 116 systolic and 84 diastolic. She was completely relieved of her preoperative symptoms, and she was employed as a hospital maid in addition to keeping house for her two children. Fundus examination revealed only mild sclerosis of retinal arterioles. Both lung fields were clear and the heart revealed nothing unusual. Her electrocardiogram was normal. Teleroentgenogram revealed a definite decrease in cardiac size to normal as compared with the preoperative film; the values for area and transverse diameter respectively were now +0.1 per cent and +5.2 per cent greater than predicted normal. The urea clearance averaged 73 per cent, and the maximum urine concentration on an 18 hour test was 1,017. Urinalysis revealed 2+ albuminuria.

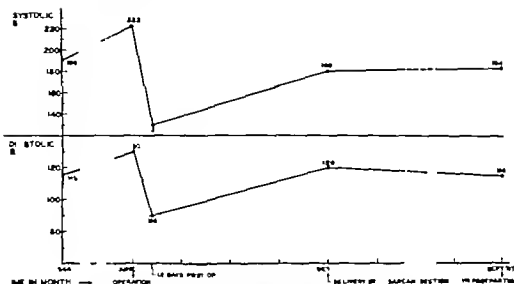


Fig. 3. Case 3, followed 3 months after splanchnicectomy

nervousness irritability tinnitus and fatigability progressively increased until June 1946 when she was studied in this hospital. She was then in the 4th month of her first pregnancy and during the previous month her headaches had increased markedly in severity and her blood pressure had risen appreciably.

On physical examination her blood pressure averaged 22 systolic and 130 diastolic in both arms, reclining. Fundus examination revealed marked generalized attenuation of arterioles, arteriovenous nicking and localized angiospasm. Both lung fields were clear. The heart showed nothing unusual. The uterine fundus was felt just above the symphysis pubis. There was no peripheral edema.

Intravenous pyelograms were normal. Blood non protein nitrogen was 24 milligrams per cent. Urea clearance was 95 per cent and 75 per cent of normal. Maximum specific gravity on an 18 hour concentration test was 1.024. Urinalysis revealed 1+ albuminuria. The electrocardiogram showed left axis deviation with normal T waves. Heart size was normal by teleoroentgenogram.

A bilateral supradiaphragmatic splanchnicectomy with lower dorsal sympathetic ganglionectomy (8th through 12th dorsal) was performed on June 7, 1946. Convalescence was uneventful and she was discharged on the 11th day.

Through the remainder of the pregnancy her blood pressure levels ranged from 130 to 180 systolic and 90 to 120 diastolic. On October 18, 1946 she was delivered of a normal female infant by cesarean section at another hospital. Her headaches were only partly relieved, and toward the end of the pregnancy she became edematous and showed a marked albuminuria.

She was examined in September 1947, almost 1 year after delivery and her blood pressure averaged 84/116. She was completely relieved of her preoperative headaches, but she still had ease of fatig-

ability. Her electrocardiogram was unchanged, and her cardiac size was still normal by teleoroentgenogram. Urea clearance and 18 hour concentration tests gave values indicating moderate impairment of renal function.

CASE 4. L. N. age 22 years, tertigravida was first discovered to have elevated blood pressure at the age of 18 during her first pregnancy which was interrupted during the second trimester because of a severe toxemia. The elevated blood pressure persisted postpartum. At the age of 20 her second pregnancy was interrupted at the end of the third month because of recurrence of toxemia. She entered this hospital in January 1944, in her third pregnancy complaining of severe headaches and impaired vision of 3 weeks duration.

On physical examination her blood pressure averaged 258 systolic and 170 diastolic. Fundus examination revealed normal optic discs, generalized narrowing of arterioles, and localized angiospasm; throughout both fundi there were small areas of pigment deposit and punctate hemorrhages. Both lung fields were clear. A systolic murmur was heard over the entire precordium. The uterine fundus was felt at the level of the symphysis pubis. There was no edema.

The intravenous pyelogram was normal, 1+ albuminuria was present. Maximum specific gravity on an 18 hour concentration test was fixed at 1.010. Urea clearance was 40 per cent and 36 per cent of normal. Blood nonprotein nitrogen was 38.5 milligrams per cent. The electrocardiogram was within normal limits, and the heart was borderline in size by teleoroentgenogram.

Bilateral supradiaphragmatic splanchnicectomy with lower dorsal sympathetic ganglionectomy (9th through 12th dorsal) was performed on February 3, 1944. Convalescence was uneventful and she was discharged on the 13th day to the care of her local

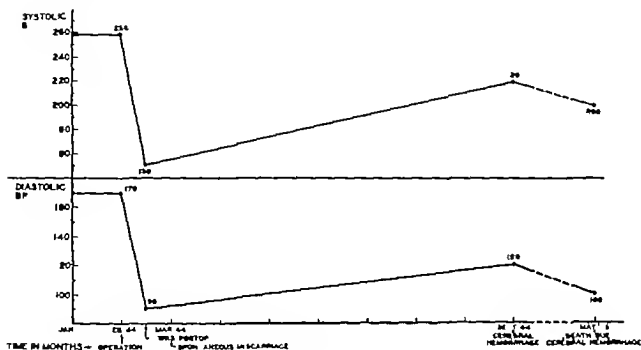


Fig. 4. Case 4, followed 13 months after splanchnicectomy

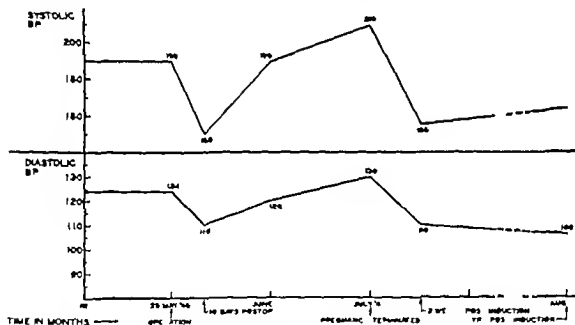


Fig. 5. Case 5 followed 57 months after splanchnicectomy

obstetrician. Her blood pressure persisted at 150/90 after operation. She had a spontaneous miscarriage on March 7 1944. In August 1944 her blood pressure began to rise, and on September 15 1944 she sustained a cerebral accident with right facial paresis. Her blood pressure levels then remained in the range of 200 to 220 systolic, and 100 to 120 diastolic. On May 23 1945 she died within an hour after a severe cerebral hemorrhage.

CASE 5 P C age 25 years, quadrigravida was first discovered to have hypertension 4 years previously in 1941 during her first pregnancy, which aborted spontaneously during the 5th month. The

elevated blood pressure persisted postpartum at an average level of 185/120. In 1942 she miscarried during the 5th month of her second pregnancy. Impaired vision and marked elevation of blood pressure had occurred. In 1943 she miscarried during the 7th month and again she had noted impaired vision. She was admitted to this hospital on May 21 1945 during the 5th month of her 4th pregnancy complaining of progressively increasing severe headaches puffiness of her face and blurred vision.

On physical examination her blood pressure averaged 200 systolic and 124 diastolic. Fundoscopic examination revealed moderate sclerosis and minimal

attenuation of arterioles, but no definite angiospasm. Both lung fields were clear and a loud systolic blow was heard over the whole precordium. The uterine fundus was almost at the level of the umbilicus. There was 2+ peripheral edema.

Intra-venous pyelogram revealed a minimal hydro-nephrosis of the right kidney and a normal left kidney. There was 2+ albuminuria. Maximum specific gravity on an 18 hour concentration test was 1.020 (moderate impairment). Urea clearance was 100 per cent and 108 per cent of average normal. Blood nonprotein nitrogen was 37 milligrams per cent. Teleoroentgenogram revealed moderate cardiac enlargement, the electrocardiogram showed QRS deflections of large voltage suggesting cardiac enlargement.

Bilateral supradiaphragmatic splanchnicectomy with lower dorsal sympathetic ganglionectomy (9th through 12th dorsal) was performed on May 28, 1945. There was no postoperative complication. She was then followed closely in the antenatal clinic and no reduction in blood pressure occurred. Toward the end of June 1945 her blood pressure gradually began to rise reaching an average level of 210/130 albuminuria progressively increased to 4+ urea clearance values diminished and marked angiospastic progression occurred in her eyegrounds. It was then decided to terminate the pregnancy medical induction of labor was carried out on July 10, 1945 and a stillborn fetus was delivered. Two weeks postpartum her blood pressure was 155/110.

Two years later in August 1947 her blood pressure levels averaged 164/106. She had no hypertensive symptoms, and she was doing the work of a farmer's wife.

ANALYSIS OF CASES

All 5 patients had prepregnant hypertensive disease and in each a toxemia occurred with pregnancy as manifested by exacerbation of hypertensive symptoms and rising blood pressure levels. Each patient in Cases 1 and 2 in which the results have been gratifying had hypertensive heart disease confirmed by teleoroentgenograms revealing cardiac enlargement and each showed evidences of impaired renal function yet their response to splanchnicectomy was dramatic. With the maintenance of normal blood pressure levels heart size in each decreased to normal on teleoroentgenogram.

In Case 3 the patient whose hypertensive disease had not yet progressed to cardiac involvement or impaired kidney function did not respond to sympathectomy her toxemia persisted until her uterus was emptied by cesarean section. She did give birth to a living infant.

In Case 4 the patient had marked impairment of renal function as evidenced by the fixed specific gravity of the urine and by the urea clearance values of 40 per cent and 36 per cent of average normal. Very little is to be expected from splanchnicectomy in patients with such marked kidney involvement. The operation was performed in the hope of aiding a patient to attain her extreme desire in giving birth to a living infant. In view of the fatal outcome 14 months after miscarriage, it is apparent that it is a mistake to do anything but interrupt a toxemic pregnancy promptly when findings of marked impairment of kidney function are present.

DISCUSSION

The therapeutic procedure of splanchnicectomy should be considered in cases of toxemic pregnancy superimposed on pre-existing hypertension before decision to interrupt the pregnancy is reached. The surgical treatment of hypertension not only affords an opportunity for relief from the toxemia and a good chance to obtain a living infant but it also presents the significant possibility of gaining a lasting relief from the underlying hypertensive state.

This forthright approach to the problem can be rationalized. The specific mechanism by which a toxemia of pregnancy is produced is not known nevertheless most investigators of this enigma consider the placenta to be the likely primary seat of the disorder. Pre-existing hypertension is one of a number of factors capable of disturbing the local circulation of the placenta, and thereby altering its hormonal activity. Hypertensive vascular disease is thus recognized as an important predisposing factor to the development of toxemia.

Splanchnicectomy has been found capable of arresting and reversing the course of hypertensive disease in some cases (6) this operation can thus be applied to this specialized problem for it may effect a reversal of the underlying hypertensive state and thereby remove the factor predisposing the toxemia.

The late vascular effects of a toxemic pregnancy have been shown by Golden, Dexter and Weiss to be directly dependent upon the duration of the toxemia, and they have pointed out that such effects may be prevented by

interrupting the pregnancy before the toxemia has persisted more than 3 weeks. Peckham found termination of pregnancy advisable in order to avoid chronic damage when signs and symptoms of toxemia persisted after 4 weeks of observation and treatment. These conclusions must not be disregarded in the management of patients treated by splanchnicectomy if the toxemia does not subside and disappear within 3 weeks following sympathectomy the pregnancy should be terminated.

Newell and Smithwick have reported a case of a patient with prepregnant hypertension upon whom lumbodorsal splanchnicectomy was performed during the first trimester. The two stage operation was done in July 1944 and the result was excellent. She maintained normal blood pressure levels for the remainder of the pregnancy and postpartum. This patient did not have a superimposed toxemia.

This treatment which utilizes splanchnicectomy is far from the complete answer to the serious problem of the prepregnant hypertensive with superimposed toxemia. However splanchnic resection may be used with reasonable hope in patients who are desirous of completing a pregnancy and whose kidney function is relatively good for some patients will respond dramatically. Unfortunately a method for determining beforehand which hypertensive patients will obtain a brilliant result from splanchnicectomy is unavailable at the present writing.

A study (7) of previously hypertensive females who experienced pregnancies subsequent to splanchnicectomy has led us to conclude that the young hypertensive female who

desires a pregnancy would do well by first having her essential hypertension treated by splanchnicectomy. If she maintains normal blood pressure levels for 1 year following operation she may attempt a pregnancy and be assured that she is reasonably protected against harmful late vascular effects and that her chances are excellent for giving birth to a normal infant.

SUMMARY

1 Splanchnicectomy has been performed in 5 cases of toxemia superimposed on prepregnant hypertension.

2 In 2 cases the results have been excellent, following operation in both, the toxemia disappeared, normal blood pressure levels were achieved living infants were obtained and normal blood pressures have persisted since delivery.

3 In the remaining 3 patients the operation exerted no influence on the toxemia but in 1 of the patients the blood pressure levels following delivery have been significantly decreased as compared to the prepregnant levels.

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A CLINICAL STUDY OF THE EFFECT OF INTERCOSTAL NERVE BLOCK WITH NUPERCAINE IN OIL FOLLOWING UPPER ABDOMINAL SURGERY

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THE purpose of this investigation was to study further the procedure of intercostal nerve injection in 50 patients in order to evaluate its efficacy in reducing postoperative discomfort and pulmonary complications following upper abdominal surgery. The use of local anesthetics in a water base probably produces analgesia of too short duration and the use of preparations in oil and benzyl alcohol may result in the development of intercostal neuritis. Consequently a mixture of 1:1000 nupercaine in peanut oil was prepared and was used throughout the course of this study. We wished to ascertain whether such a preparation would give sufficiently prolonged analgesia without undesirable side effects. Pulmonary complications and postoperative pain are still vital problems to the surgeon especially following upper abdominal procedures, and any ancillary measures that can be directed to their prevention would be worth while.

The general improvement in operative mortality in the last decade has been due, to a large extent to the attention given the multiple details of preoperative and postoperative care. Despite the decrease in the problems of sepsis as a result of chemotherapy the incidence of postoperative pneumonia, atelectasis and venous thrombosis remains high. These complications now constitute the majority of the difficulties to which the patient operated upon falls heir. The exponents of early ambulation (13) have tended to show a decreased incidence of these complications attendant on the use of that regimen. Early

ambulation unquestionably offers many real benefits to the patient. However the practical application of it to the individual is often hampered by the discomfort of motion or by the sedation or narcosis applied for its amelioration. In spite of a general improvement in the various aspects of postoperative care, the constant factor of pain is with few exceptions, being controlled in the same manner today as in the past. If the disadvantage of narcotic administration lay only in the necessity for frequent application there would be little stimulus for changing present methods. However it is felt by many that there might be causal relationship between the control of pain by narcotics and the etiology of pulmonary complications.

Brock has outlined the factors influencing the incidence of postoperative pulmonary complications as follows (a) adequacy of preoperative prophylaxis (b) the type of operation with its possible sequelae of distention, peritonitis and diaphragmatic splinting (c) type and duration of anesthesia, (d) general condition of the patient, (e) sex and (f) season of the year. Most of the factors enumerated by Brock are either beyond the control of the surgeon or can be minimized by judicious preparation of the patient. However when operating to remove a disease process in the upper abdomen the surgeon is forced to accept the added responsibility of the high incidence of pulmonary complications in this area.

Cutler and Hoerr have stated that the type and duration of anesthesia are of secondary importance to the site of operation and the general condition of the patient. It is generally agreed that the highest incidence of pulmonary complications occurs following upper abdominal procedures. This adds to the mortality of an already formidable procedure, and

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presents a great challenge for study of the possible cause and prevention of pulmonary complications.

The pulmonary complications that endanger life or prolong morbidity are atelectasis and pneumonia. According to one theory it is felt that patchy or lobular atelectasis occurs first, and is either alleviated or goes on to bronchopneumonia. It is a well recognized clinical observation that the decrease in respiratory excursions following upper abdominal surgery can lead to the conditions that favor the occurrence of atelectasis. This depression of respiratory excursion is intimately associated with pain from the operative incision and many methods have been employed in an attempt to reduce this postoperative discomfort. Thus, tight abdominal binders and narcotics are used to decrease pain of motion and coughing. Since the abdominal muscles are active in respiration, there is a reluctance to take deep breaths because of the associated pain. Control of pain by narcotics, bed rest and tight dressings is a mixed blessing to the patient, however, since they reduce the tendency for activity, reduce the cough reflex and favor accumulation of bronchial secretion. Given these conditions, the occurrence of atelectasis will be frequent.

The effect of pain stimuli arising in the incision has been studied by Patey. By preoperative and postoperative x ray comparisons, he demonstrated a marked reduction of diaphragmatic excursion following abdominal surgery. He further states that deep breathing exercises were of little avail because of the splinting of the abdominal wall and that narcotics made the motion of the diaphragm more sluggish.

Kahn has shown by his experiments with dogs that stimulation of the central end of any intercostal nerve or of its branches to the abdominal muscles, causes a reflex inhibition of respiration. This reflex to the diaphragm was not abolished unless all of the lower intercostal nerves were sectioned.

Starr and Gilman state that expansion of the lower lobes closely follows the motion of the sixth through the tenth ribs and their attached muscles. These muscles are coordinated with the diaphragm and are its antago-

nists. Therefore, spasm in the flat abdominal muscles will prevent full diaphragmatic excursions as well as motion of the lower ribs.

In the past, several plans for controlling pain from the incision have been tested, and include Capelle's method of continuous infiltration of the abdominal wall with novocain. Crile's injection of the abdominal wall about the wound with quinine and urea hydrochloride, and the blocking of the intercostal nerves with various agents. Only the latter has received any widespread study and appears to have the least deleterious effects for the result accomplished. The effectiveness of such blocks has been measured by the decrease in the amount of narcotics needed to control pain and by the changes in vital capacity. The use of the former as a basis of judgment is known to be less accurate because of the variation in individual pain tolerance and because narcotics are often given on orders to give when necessary for the relief of restlessness or to produce sleep. Although the study of vital capacity is also subject to error it is a simple and objective test and is much more reliable.

There is ample evidence attesting the consistency and extent of the drop in vital capacity following upper abdominal surgery. Churchill and McNeil found that the percentage of preoperative vital capacity present 24 hours postoperatively was 25 per cent, while Powers recorded an average of 33 per cent and Beecher 42 per cent. All speak of the greatly increased drop in the upper abdominal cases as compared with those in the lower abdomen.

That intercostal block can reduce the amount of narcotics and the decrease in vital capacity following upper abdominal surgery has been supported by various investigators. Gius performed paravertebral intercostal nerve blocks with novocain on 2 patients with atelectasis. He observed a relief of pain and that the patients were able to cough freely and raise mucus plugs resulting in cure of the atelectasis. One of us (18) studied 15 cases by injecting the sixth to the eleventh intercostal nerves in the midaxillary line with eucupine in oil containing benzyl alcohol and demonstrated a definite reduction in the expected postoperative drop in vital capacity. Starr and Gilman used a eucupine-novocain mixture

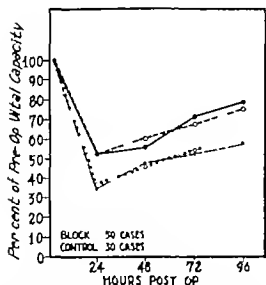


Fig. 1 Average block, o—o— median block — — average control, oooooo median control

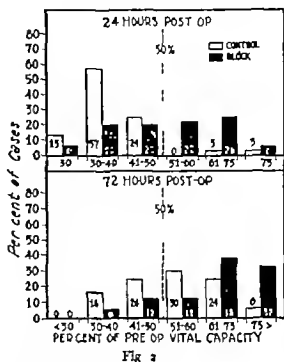


Fig. 2

Narcotic requirements All postoperative orders were written to include an order for morphine or other narcotic, every four hours if necessary for the control of pain. The decision as to the necessity for its administration was left to the nurse working with the case. They were not informed as to which cases had been injected and a comparison of narcotic usage in the two series should be valid on this point at least.

Pulmonary complications Those cases were counted as pulmonary complications when the course of patient's recovery was impeded by changes in the respiratory system. All patients were not routinely examined by x ray postoperatively. The usual clinical signs and symptoms were relied upon as indication for x ray examination. In general when there was an unexplained temperature elevation, questionable physical signs, respirations greater than 28 per minute, cough, pain in the chest, or cyanosis an x ray film of the chest was obtained for confirmation of atelectasis or pneumonia.

RESULTS

Vital capacity The well demonstrated drop in vital capacity on the first postoperative day has been previously mentioned and is in the range of 25 to 42 per cent of the preoperative level in different series. In our control series the average first day postoperative

vital capacity was 37 per cent of the preoperative level and the median was 36 per cent (Fig. 1). In opposition to these series Leithauser, employing early ambulation, has reported 7 patients having a vital capacity of 48 to 85 per cent on the first postoperative day following biliary surgery. Our control group was given the benefit of early ambulation and isolated cases in this group often fell within the range mentioned by Leithauser. In the larger group, however, such a high average is not maintained.

Figure 1 also shows that the injected series has an average and a median of 53 per cent of preoperative vital capacity at the end of 24 hours compared with 36 or 37 per cent in the controls. It is also noticeable that this order of difference is maintained throughout the first 4 days at least, and the control group does not approach the experimental at any point. Roughly patients in the blocked group reach a certain vital capacity 48 hours before the controls, i.e. experimental, 53 per cent on the first postoperative day; controls, 53 per cent on the third postoperative day.

Figure 2 is a graphic expression of the same data from a different standpoint. It will be seen that at the end of 24 hours postoperatively 54 per cent of the block series have more than 50 per cent of preoperative vital capacity, as against only 6 per cent of the controls.

TABLE II.—PULMONARY COMPLICATIONS

	Control	Block
Median age	46	45
Sex—per cent		
Male	40	58
Female	60	42
Pulmonary complications—per cent	13	6
Routine penicillin—per cent	37	20

speak a failure of the block is suggested by an average of 50 per cent vital capacity at 24 hours in those patients needing as many or more hypodermic injections than the average control

Pulmonary complications The same policy of early ambulation was applied to the control and blocked series and closely followed the first day ambulation plan of Leithauser

The difference between the sexes in the incidence of pulmonary complications is marked, as Cutler and Hoerr have shown an approximate 2 to 1 ratio of males to females. Blodgett and Beattie an incidence of 14.2 per cent in males and 5 per cent in females and Beecher a 3 to 1 preponderance in males.

That upper abdominal operations in themselves carry a very high incidence of pulmonary complications is suggested by Cutler and Hoerr's finding of an 11 per cent incidence in biliary tract procedures and 23 per cent in operations upon the stomach by Murphy who found 29 lobular and lobar atelectases of varying degrees in 100 gastrectomies and by Blodgett and Beattie who found 11 per cent pulmonary complications in first day risers and 13 per cent in nonearly risers following upper abdominal procedures. The figures of Murphy and of Cutler and Hoerr show a higher incidence after gastric procedures than in other upper abdominal surgery.

There is general agreement that advanced age with its attendant physical deterioration leads to a greater incidence of pulmonary complications.

A study of Table II shows that the 13 per cent incidence of pulmonary complications in the control, although the series is small, agrees well with the findings of larger series. The median age of the two groups are close enough to be disregarded. The preponderance of males and the routine use of penicillin postoperatively in only 20 per cent of the block series versus 37 per cent of the control

TABLE III.—OPERATIVE PROCEDURES

	Control	Block
1 Biliary tract.	15	15
2 Vagotomy ± gastroenterostomy	4	12
3 Gastrectomy	6	5
4 Splenectomy	4	8
5 Esophagogastronomy		3
6 Miscellaneous upper abdominal.	1	7
Total	30	50

group does not detract from the significance of the reduction to 6 per cent pulmonary complications in the experimental group. In addition Table III shows that 40 per cent of the procedures in the block group were upon the stomach, compared to but 33 per cent in the controls. Another interesting fact is that all pulmonary complications in both groups occurred following gastric surgery. Admittedly the difference between 6 and 13 per cent in a series of this size is not of statistical significance. However as mentioned above with all the factors tending to produce an increased incidence of pulmonary complications, 'stacked,' as it were against the experimental series, the difference may be real.

SEQUELAE OF PROCEDURE

In the hospital In no instance did a sterile abscess or infection develop in the thoracic wall from the presence of the oil.

In no instance did we observe a pleural type pain or pleural effusion from the procedure.

There were no cases of wound evisceration connected with the decrease of abdominal wall sensitivity.

As previously mentioned, two pneumothoraces did occur and must always be kept in mind.

After discharge Of the 40 cases blocked up to 2 months ago 33 have been followed. Twenty two were reached personally and 11 by questionnaire. There has been no instance of abdominal or thoracic pain suggestive of an intercostal neuritis.

DISCUSSION

In assessing the value of the anesthetic agent, we feel that evidence indicates it is still producing benefits on the second and third postoperative days. That this may be of sufficient duration in contradistinction to

AN EXPERIMENTAL STUDY OF THE COMPARATIVE EFFICACY OF HEPARIN AND DICUMAROL IN THE PREVENTION OF ARTERIAL AND VENOUS THROMBOSIS

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THE value of the anticoagulant drugs heparin and dicumarol has been well established in recent years. The two drugs differ considerably in cost, methods of administration, and means of control of safe and effective dosage. They also differ somewhat in regard to the reactions and complications which may occur in hypersensitive individuals or with overdosage. It is of paramount importance that proper selection of the anticoagulant agent of choice must take into consideration, in addition to these factors, the comparative efficacy of the two drugs in the prevention of arterial and venous thrombosis. As far as we can ascertain, no such study has been recorded in the literature. The experiments reported in this communication were undertaken in an effort to compare, under controlled experimental conditions, the reliability of the two drugs in the prevention of arterial and venous thrombosis.

MATERIALS AND METHODS

The experiments were carried out upon healthy mongrel dogs ranging in weight from 5 to 20 kilograms; the majority weighed from 10 to 15 kilograms. The common carotid arteries, the external jugular veins, and the femoral arteries and veins were utilized. These vessels proved particularly suitable for the purpose of the study, being easily accessible, sufficiently large, and with few enough branches that a fairly long segment could be isolated with ease. The axillary vessels were not found suitable because of their small size, numerous branches, and relative inaccessibility. The

radial veins in the forepaw did not prove satisfactory either when exposed directly by operation or when injected through the intact skin. In most of the experiments only one of the jugular veins was traumatized, the other being used for withdrawal of blood for study.

In our preliminary efforts to find an efficient and reproducible means of inducing thrombosis in a high percentage of untreated animals, and yet one capable of prevention by the use of anticoagulants, numerous methods were tried and subsequently abandoned. They included the following attempts to produce venous thrombosis: (1) Double partial ligation with silk or No. 000 chromic catgut with a 1 inch segment between the ligatures, as outlined by Potts and Smith; (2) double partial ligation with silk or catgut combined with forceful stretching of the intervening segment as suggested by Rabinowitch and Pines; (3) partial penetrating ligatures of silk or No. 000 chromic catgut so as to narrow the lumen and at the same time leave a foreign body inside the intimal layer of the veins. Preliminary attempts to obtain satisfactory arterial thrombosis included the methods just mentioned and also the following: (1) application of one Kelly clamp at full tension across the artery for 20 seconds; (2) application of several Kelly clamps at full tension across the artery for 20 seconds; (3) double partial ligation with silk or catgut and application of multiple Kelly clamps at full tension across the intervening segment for a period of 20 seconds. These methods were all discarded because the results obtained with each were too variable.

The methods finally adopted and applied in all the animals included in this study were as follows. The arteries were dissected free and

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blood was excluded from a segment 1 to 2 inches in length by the use of rubber band tourniquets. The artery was transected through half its circumference with small ophthalmic scissors. The adventitia was not stripped only long coarse fragments hanging from the artery were clipped off. A rough closure with little or no eversion of the approximated margins was effected by a continuous over and over suture of No 5 Deknatel silk. The carotid arteries were cut and closed transversely while the femoral arteries were cut transversely but closed longitudinally. There was, consequently definite narrowing of the sutured femoral arteries. Hemostasis proved a considerable problem in those animals treated with heparin or dicumarol. The bleeding could be brought under control in almost all instances however by use of gentle pressure over the suture line, additional sutures and liberal use of hemostatic globulin. The veins were similarly dissected free and blood was excluded from a one to two inch segment by rubber band tourniquets. The isolated segment, free of blood was then distended maximally with 5 per cent sodium morrhuate solution which was introduced through a fine needle. It was left in the vein for a measured period of from 3 to 4 minutes. The morrhuate was then withdrawn by aspiration the rubber bands were released, and blood flow re-established. Nembutal anesthesia was used. All the operations were carried out under aseptic conditions. An effort was made to achieve complete hemostasis before closure. Silk ligatures were used, and the skin was approximated with interrupted black silk sutures. The dogs were all fed the usual kennel ration both before and after operation.

Except where it is specifically mentioned, the vessels were not reexamined until 7 days after operative trauma. First the exposed vessel was inspected grossly and palpated gently for thrombosis at and near the site of the previous trauma. Notes were made concerning the presence or absence of free flow of blood through this area, normal filling of the veins proximally and distally and pulsation of the arteries distal to the sutured area. Such observations were usually sufficient to establish whether thrombosis had, or had not, oc-

curred. In doubtful cases the veins were transected proximal to and the arteries distal to the injured segment in order to see whether blood flowed freely through it. Finally the vessels were excised and opened widely in order to verify the other observations.

Before and each day following operation, blood was withdrawn by venipuncture for determination of coagulation time, fibrinogen level and prothrombin time. The Lee White two tube method was used for determination of coagulation time in some of the later experiments this method was supplemented or replaced by the capillary tube technique of Kruse and Mores. Fibrinogen estimation was carried out according to the technique of Mylon, Winternitz and de Suto-Nagy. Prothrombin times were determined both on whole and diluted plasma. Quick's method (7) was used for whole plasma while the Wright Prandoni modification was employed on a 25 per cent dilute plasma, fresh 0.5 per cent fibrinogen in normal saline solution being used as the diluent. In order to be able to express the prothrombin values in per cent of normal curves were established by multiple determinations upon various dilutions of samples of normal dog plasma in a manner similar to that utilized by Quick in establishing normal curves for human and animal plasma (6). Whole plasma was diluted to a concentration of 75, 50 and 25 per cent and the prothrombin time was determined for each sample. Using a minimum of 10 different plasma readings for each dilution, we obtained a mean from which a straight line graph on log-log paper was constructed. This same technique was utilized to obtain a straight line representation for samples of normal undiluted plasma with prothrombin times of 4, 4.5, 5, 5.5 and 6 seconds these values constituted the range of prothrombin times encountered with the type of thromboplastin used. In order to obtain straight line representation for the dilute plasma, we repeated the above process using a primary 1:4 dilution as 100 per cent and in turn diluting this to 75, 50 and 25 per cent. Again samples with whole prothrombin time values varying from 4 to 6 seconds were used. While we do not feel that our percentages were strictly accurate we do believe they did not have

much over a plus or minus 3 per cent error which was sufficiently accurate for this study.

The administration of anticoagulants was always begun beforehand in order to have an effective level at the time the vessels were traumatized. Dicumarol was administered intravenously in a sodium hydroxide solution made according to instructions of Overman and his associates, a 10 milligram per cubic centimeter solution was used. The drug was given 24 hours before operation. In the initial experiments a 25 milligram dose was given preoperatively and as frequently after operation as was required to maintain the prothrombin percentage at the desired level. In all succeeding experiments the dicumarol was given initially in doses of 2 or 3 milligrams per kilogram of body weight and subsequently in doses of 1 or 2 milligrams per kilogram given when indicated by the daily prothrombin determinations. Crystalline heparin was administered intravenously immediately before operation. The dosage ranged from 0.5 to 4 milligrams per kilogram of body weight; the drug was given at intervals of from 2 to 4 hours. When heparin in Pitkin's menstruum (3) was used it was given intramuscularly or subcutaneously in doses ranging from 5 to 10 milligrams per kilogram of body weight. In some animals heparin was given intermittently by intravenous injection throughout the day while a single injection of heparin in Pitkin's menstruum was administered in the evening in order to maintain a prolonged coagulation time until the following morning. At least one coagulation time estimation was performed daily upon each dog, the blood generally being withdrawn immediately before an injection of heparin in order to determine the lowest coagulation times prevailing. In some of the dogs the coagulation time was tested just before a number of successive injections of heparin. In addition some coagulation time studies were performed shortly after injections of heparin in order to study maximal effects.

RESULTS

Experiments were carried out upon 84 dogs but only 70 of these were suitable for statistical comparison and are included in this analysis. The remainder is comprised of the

animals used in the preliminary survey of methods of producing thrombosis; a few died of causes necessitating their elimination from this study. The last group is included however in the analysis of complications resulting from the use of the two anticoagulant agents. Fifteen dogs served as controls, 25 received dicumarol in varying amounts and 30 were heparinized for different periods of time.

Altogether 228 veins and 177 arteries were traumatized and subsequently examined for thrombosis. Since all of the veins were roughly of the same caliber they are grouped together. The carotid arteries had an external diameter of from 4 to 5 millimeters and are grouped together for purpose of analysis, as large arteries. The femoral arteries were smaller, having a diameter in the neighborhood of 3 millimeters; they are referred to as small arteries. In addition, as we have mentioned previously, the diameters of the femoral arteries were deliberately reduced further by suturing the transverse incision longitudinally.

Certain data relating to prothrombin time and coagulation time values are included in the tables. It should be pointed out that our observations established the fact that the administration of dicumarol 24 hours before operation resulted in a diminishing level of prothrombin at the time of operation and an increasing effectiveness of the drug during the critical early postoperative period. Attention should also be called to the fact that our studies revealed that heparin in Pitkin's menstruum given in the dosage employed invariably resulted in adequate prolongation of coagulation time for a period ranging from 12 to 24 hours, thus insuring increased coagulation time during the night period in which intermittent intravenous heparin was omitted in certain instances. Repeated clotting time studies showed that rarely if ever was the clotting time kept elevated during the entire 4 hour period between injections of heparin, regardless of the dosage employed.

Fifteen dogs served as controls. The vessels of 9 of them were examined 7 days after operation (Table 1, section 1). This period of time was chosen arbitrarily as one in which we might be reasonably sure that thrombosis would be evident were it destined to occur. In

TABLE L—INCIDENCE OF THROMBOSIS IN CONTROL ANIMALS

Number of dog	Interval between vessel trauma and inspection for thrombosis, in days	Veins		Small arteries		Large arteries	
		No thrombosis	Thrombosis	No thrombosis	No thrombosis	No thrombosis	No thrombosis
Section 1							
301	7	3	3				
3	7	3					
131			3				
30	7	3	3				
13	7	3					
100	7	3					
16	7	3					
173	7	3					
163		3					
Total	7	27	3	4	3	18	66 7
Per cent			100		75		
Section 2							
320			3				
31		3					
343		3					
Total			100		30	6	83 3
Per cent			100		30	6	83 3
Section 3							
134			3				
34		3	3				
143		3	3				
Total		6	100	6	83 3	6	66 7
Per cent		6	100	6	83 3	6	66 7
Grand Total		1	9	4	30	30	81 70
Per cent		1	9	4	30	30	81 70

this group comprising 27 veins, 14 small and 18 large arteries, thrombosis was present in 85 2 per cent of the veins, 91 9 per cent of the small arteries, and 66 7 per cent of the large arteries. In order to learn whether thrombosis would be evident much sooner if it were going to occur at all the vessels of 3 dogs were examined 24 hours and 3 others 48 hours after injury. The incidence of thrombosis in the first (24 hour) group was 100 per cent for veins, 50 per cent for small arteries, and 83 3 per cent for large arteries. In the latter (48 hour) group the figures were 100 per cent 83 3 per cent, and 66 7 per cent, respectively. The two groups combined had an incidence of thrombosis of 100 per cent for veins, 70 per cent for small arteries and 75 per cent for large arteries. These results do not differ ma-

tenally from those found in the group examined 7 days after operation. In order to ascertain whether any additional thrombosis occurred after the early examination the vessels of one dog (No 321) were examined with aseptic precautions in 24 hours and later 7 days after operation. Another (No 328) in 48 hours and again 7 days after operation. In neither were there more arterial or venous thromboses in 7 days than were present in 24 or 48 hours. Altogether it appeared evident that thrombosis following the experimental vessel trauma utilized in these studies occurred within the first 48 hours. Combining all the control studies it was found that there were thromboses in 91 1 per cent of the veins, 83 3 per cent of the small arteries, and 70 per cent of the large arteries.

In Table II are listed blood studies upon the control animals examined 7 days after the vascular injury. The coagulation time was generally shortened on the first postoperative day. In 5 of the 9 dogs there was a measurable increase in circulating prothrombin but in only 4 of the 5 was the prothrombin per cent increased with significant regularity. The fibrinogen determinations revealed wide variations from one day to another but seemed to follow a fairly regular pattern consisting of a sharp rise on the first or second day with gradual subsidence toward normal. There appeared to be a tendency in a few animals for a secondary rise to occur on the sixth or seventh day.

HEPARIN

The effect of varying amounts of heparin upon the incidence of thrombosis was studied in 30 dogs. Eleven animals were given crystalline heparin intravenously before operation and every 4 hours after operation for a varying number of days (Table III section 1). Two were treated for 7 days, 6 for 6 days and one each for 5, 4, and 3 days. The average duration of treatment was a little less than 6 full days. In a few dogs heparin in Pitkin's menstruum was given every evening in sufficient amount to maintain a good anticoagulant effect until the following day. The details of the drug administered are given in Table IV. Under this regimen the incidence of thrombosis at the end of the period of treatment was 56.3 per cent in the case of veins, 6.7 per cent in the case of small arteries and 9.5 per cent in the case of large arteries.

The results of the blood studies in these animals are recorded in Table IV. Of considerable interest is the wide fluctuation in coagulation time from one examination to another in the same animal and in different animals being given the same dosage of the drug. Of particular significance is the fact that a prolonged clotting time was generally not maintained in any animal for the entire duration of the experiment. Indeed the clotting time in all animals tended to return to a normal or near normal level periodically before each new dose of heparin was administered. For the sake of brevity all of the coagulation times performed are not listed only the first test per

TABLE II — BLOOD STUDIES IN UNTREATED DOGS
SUBJECTED TO ARTERIAL AND VENOUS INJURY

N. mbe of dog	Days after operation	Lee-White coagulation time in minutes	Prothrombin time of whole plasma, in per cent	Prothrombin time, diluted plasma, in per cent	Fibrinogen in mgm. per cent
09	P	5	00		4.41
		4.5	50	50	5.00
	3	4.5	25	25	8.07
	4	7	35	50	6.7
	6	6	25		7.23
15	P	2.5	190	30	4.48
					7.6
	3		100	100	8.8
	4	5	14	90	5.04
	6	1	130	140	7.63
3	P	0.5	100	100	7.14
	10	6	100	100	6.83
		7	48	50	6.5
	3	6.5	00	100	7.33
	6	8	00	100	8.7
30	P	9	00	00	5.7
	10	7	100	5	5.43
	3	6	5	30	5.78
	4	3.5	90	120	
	6	8	00	00	6.27
24	P	4	100	00	4.45
		3	75		5.37
	3	6	00		4.33
	4	6	00		7.43
	6	7	00		4.30
260	P	9	00		8.5
	10	4.5	00		9.5
	3	6	15		9.7
	4	3	75		6.0
	6	6	68		8.3
268	P	7	00		7.5
	3	3	90		
	4	8	100	135	6.05
	6	4	70		8.73
	6	3	04		27
275	P	4.5	100		9.97
		4			
	3	3	00	00	4.4
	4	2.5	00	100	9.33
	6	4	90	100	8.51
283	P	4	00		9.05
		3	90	87	0.7
	3	6	100	00	0.7
	4	2.5	00	00	10.25
	6	6	00	00	
283	P	4	00	00	4.60
		3.5	00	00	8.57
	3	7	00	00	7.29
	4	6	00	100	7.08
	6	8	00	00	8.75
283	P	6	00	00	0.1
		6	00	00	8.47
	3	7	00	00	
	4	6	00	00	
	6	8	00	00	

P—Preoperative

10—Day of operation

TABLE III.—INCIDENCE OF THROMBOSIS IN ANIMALS TREATED WITH HEPARIN

No. of dog	Duration of heparin therapy in days	Interval between vessel transection and inspection for thrombosis, in days	Vena		Small arteries		Large arteries	
			No. transected	% thrombosed	No. transected	% thrombosed	No. transected	% thrombosed
Section								
277	5	5						
298	7	7	2					
294	5	5	2					
297	6	6	2	2				
298	6	6	2	2				
299	5	5	2					
3	6	6	2					
21	7	7	2					
237	6	6	2					
212	5	5	2					
210	6	6	2					
Total			12	2				
Per cent	2-7	2-7	22	15.2	3	67		9.1
Section A4								
222			2					
237		7	2					
224			2					
225			2					
223			2					
240		7	2					
Total		64 hr	12	9				
Per cent		7 days		5				
Total				47.2				
Per cent								
Section B								
224			2					
215			2					
247			2					
237			2					
201		7	2	2				
203		7	2					
Total		2	4	2				
Per cent			24	20.8				
Total		7		8				
Per cent				66.7				
226		2	2					
237	3	7	2	2				
Total		7	2					
Per cent			8					
Total	3	7	7	4				
Per cent				17				
Total	1, or 2	1, or 2	16	7				
Per cent				12.9				
Total	1, or 2	7	16	17				
Per cent				28.7				
Section 3								
264	Single Dose	7	2					
272	"	7	2	2				
291	"	7						
292	"	7	2					
293	"	7	2					
Total	Single Dose	7	4					
Per cent		7	16	66.7	16	100	100	5.0

formed each day is given. The inconstancy of the prolongation of clotting time is not so evident from the data recorded in the table, as it is from repeated clotting time studies done just before several successive injections of heparin. Only in one dog (No. 319) was any tendency to hyperprothrombinemia manifested after operation while in 2 (Nos. 277 and 311) the prothrombin percentage was reduced on a single occasion when the coagulation time was very prolonged. On numerous occasions a markedly prolonged coagulation time was found without simultaneous reduction in prothrombin. The pattern of the fibrinogen studies after operation was similar to that noted in the controls.

Because of the failure to maintain a prolonged coagulation time constantly in these experiments and because of the rather poor effectiveness of this therapy in the prevention of venous as compared with arterial thrombosis, more adequate heparinization was carried out for a short period of time in dogs with traumatized veins. Six dogs operated upon in the usual manner, were given large doses of heparin in Pitkin's menstruum. Careful checks of coagulation time revealed a constant and effective prolongation in each instance during a period of 24 hours. At the end of this period the veins of each dog were examined under aseptic technique; the wounds were resutured and the vessels of the 3 which survived for 1 week were re-examined at the end of that period. Precisely the same type of experiment was carried out upon 6 additional dogs with the exception that effective heparinization was maintained during the first 48 hours at the end of which time the first inspection of the vessels was made. In the first group only 9.1 per cent of the veins were thrombosed at the end of 24 hours while 45.5 per cent were thrombosed in 7 days (Table III section 2). Similarly in the second group 20.8 per cent of the veins were thrombosed in 48 hours and 66.7 per cent in 7 days. In 2 additional animals the clotting time was maintained constantly prolonged for 72 hours. At the end of this period none of the veins was thrombosed, but in 7 days thrombosis was present in 57.1 per cent. If the results of these 3 experiments are combined, it is seen that at the end of

adequate heparinization for 1, 2, or 3 days only 7 of 54 veins were thrombosed (12.9 per cent) while in every animal which survived for a week after operation additional thromboses had occurred after cessation of treatment. Seventeen of the 30 traumatized vessels in the surviving animals were thrombosed in 7 days (56.7 per cent).

Five dogs were given a single intravenous dose of heparin in amounts of 2 milligrams per kilogram of body weight just before operation. No further anticoagulant therapy was administered. At the end of 1 week thrombosis was present in 62.5 per cent of the veins, 10 per cent of the small arteries and 30 per cent of the large arteries (Table III section 3).

DICUMAROL

The effect of dicumarol upon the incidence of thrombosis was studied in 25 dogs which received the drug in varying dosage and for different periods of time. In 10 animals treated before, and for an average of 6 days after, operation and in which the prothrombin per cent was kept rather consistently low thrombosis occurred in 41.4 per cent of the traumatized veins, 50 per cent of the small arteries and 15.8 per cent of the large arteries (Table V, section 1). Five of them were treated for 7 days, 3 for 6 days, 1 for 5 and 1 for 3 days. The details of administration of the drug and of the blood studies are recorded in Table VI. The prothrombin levels were almost uniformly low and the results are not significantly different in those in which all the values were very low and in those in which the prothrombin percentage was somewhat higher on one or more determinations. The blood fibrinogen response to the operative procedure was essentially the same as that noted in the control group. The coagulation time studies revealed a direct relationship to the prothrombin level, an increase in coagulation time was generally noted when the prothrombin percentage was below 20.

In 4 dogs a low prothrombin level was not constantly maintained. In one the prothrombin percentage was 100 on the third day in the others it was 50 or greater on several occasions. In these animals the incidence of thrombosis was greater than in the first group,

TABLE IV.—BLOOD STUDIES ON DOGS WITH ARTERIAL AND VENOUS INJURY TREATED WITH HEPARIN—Continued

No. of dog	Days after operation*	Lee-White coagulation time, in min.	Prothrombin time of whole plasma, in per cent	Prothrombin time diluted plasma, in per cent	Fibrinogen, in mgm.	Heparin administered mgm./kgm.†	Remarks
311	0	65	100	100	578	q 4 h. At night o Pitkin's I.M.	
	1	50	41	47	835	q 4 h. At night s Pitkin's I.M.	
	2	5	100	100	—	q 4 h. At night s Pitkin's I.M.	
	3					q 4 h. At night s Pitkin's I.M.	
	4	13	100		707	1 q 4 h. At night s Pitkin's I.M.	
	5	11	100		704	1 q 4 h. At night s Pitkin's I.M.	
	6	14	100				
312	0	7	100	100	345	1 q 4 h. At night 10 Pitkin's I.M.	
	1	7	00	100	595	1 q 4 h. At night o Pitkin's I.M.	
	2					1 q 4 h. At night s Pitkin's I.M.	
	3	15	100		684	q 4 h. At night s Pitkin's I.M.	
	4	10	100		634	q 4 h. At night s Pitkin's I.M.	
	5	24	100		63	1 q 4 h. At night s Pitkin's I.M.	
	6	6	100		525	q 4 h. At night s Pitkin's I.M.	
	7	7	100		501	—	
317	0	5	100	100	653	q 4 h. I.M. Initial dose given I.V.	
	1	8	00	100	75	q 4 h. I.M.	
	2	15	00	100	1008	1 q 4 h. I.M.	
	3					q 4 h. I.M.	
	4	0	00			1 q 4 h. I.M.	
	5	35	100		1008	q 4 h. I.M.	
	6	20	00		880	1 q 4 h. I.M.	
318	0	55	100	00	55	q 4 h. I.M. Initial dose given I.V.	
	1	17	100	100	732	q 4 h.	Large hematomas. Transfusion 150 c.c. blood.
	2	18	100		879	q 4 h.	Transfusion 50 c.c. blood.
	3					1 q 4 h.	
	4					—	Found dead.
319	0	6	100	100	390	1 q 4 h. I.M. Initial dose given I.V.	
	1	45+	115	120	406	1 q 4 h.	
	2						
	3	20	67		378	1 q 4 h.	
	4	4	82		380	1 q 4 h.	
	5	12			362	1 q 4 h.	
	6	14	82		352	1 q 4 h.	

*0—Day of operation. Studies recorded done before operation.

†Unless otherwise stated, drug was given intravenously. I.M., intramuscular injection.

TABLE V—INCIDENCE OF THROMBOSIS IN ANIMALS TREATED WITH DICUMAROL

[illegible]

TABLE VI.—BLOOD STUDIES OF DOGS WITH ARTERIAL VENOUS INJURY TREATED WITH DICUMAROL

No. of dog	Days after operation	Lee-White coagulation time in min.	Prothrombin time of whole plasma in per cent	Fibrinogen in mgm. %	Dicumarol administered in mgm./kgm.	No. of dog	Days after operation	Lee-White coagulation time in min.	Prothrombin time of whole plasma in per cent	Fibrinogen in mgm. %	Dicumarol administered in mgm./kgm.
211	P O	7 4 3-5 3 4 4-5 7	100 86 70 45 30 55	5.1 — 6.45 6.55 3.46 5.05	5	245	P O	6 3 20	100 100 90 45	4.03 2.5 2.5 2.5	2.5
213	P O	8 4 3 4 5 6 7	100 45 ^ ^ ^ ^ ^	4.65 3.15 3.70 3.00 3.15 2.02	5 5 5 5 5 5 —	27	P O	8 5 5 10 6 7	100 3 100 45 1 65 100	5.75 5.74 7.40 8.80 — 3 2.8	5 — — — — 5
220	P O	9 11 11 19 20	100 45 ^ ^ ^ ^ ^	3.5 6.05 6.65 8.66 8.00 8.02	5 5 5 5 5 5	25	P O	6 14 3 7 14	100 45 ^ ^ ^ ^	0.77 3.50 9.14 1.34 0.14 10.78 1.4	5 — — — — 5
24	P O	6 7 7 30 4 4 7	100 60 30 70 70 45 45	4.82 7.1 6.05 5.35 6.5 6.5	5 5 5 5 5 5 5	251	P O	7 5 3 4 19 3 7	100 45 10 14 80 45	4.03 6.60 7.70 7.91 7.8 6.17 7.60	5 5
244	P O	3 7 9 13 3	100 40 ^ ^ ^ ^ ^	4.30 5.5 5.6 5.30 5.5	5 5 5 5 5	252	P O	7 3 7 3 4 3 1	100 75 3 40 3 3	5.28 7.47 8.30 8.05 6.9 8.5	5 — — — — — —

P—Preoperative.

O—Day of operation. The blood studies were performed before the operation.

Dog 215 died. Large hematoma of thigh.

Dog 215 died. Massive hemorrhage from femoral artery.

the values being 75 per cent for veins 75 per cent for small arteries and 41.9 per cent for large arteries (Table V section 2)

In 6 dogs in which only veins were traumatized, excessive amounts of dicumarol were given for the first 24 or 48 hours with maintenance of very low prothrombin levels. In order to terminate the anticoagulant effect each animal received a transfusion of 150 cubic centimeters of fresh blood and 30 milligrams of vitamin K parenterally. In 3 the anticoagulant therapy was maintained for 24 hours in 3 for 48 hours. In the first group none of the veins were thrombosed at the end of 24 hours, while 36.4 per cent were thrombosed at the end of a week. In the latter group one-third were thrombosed in 48 hours and 60

per cent in 7 days. When the two are combined it is seen that the incidence of venous thrombosis was 16.7 per cent at the end of the short period of treatment and 47.6 per cent at the end of the week (Table V section 3)

Five dogs were given 5 milligrams per kilogram of body weight of dicumarol 24 hours before operation and no further anticoagulant therapy. One week after operation 75 per cent of the traumatized veins, none of the small arteries, and 44.4 per cent of the large arteries were thrombosed (Table V, section 4)

COMPARISON OF RESULTS IN ANIMALS TREATED WITH HEPARIN AND WITH DICUMAROL

Table VII compares the incidence of thrombosis from 5 to 7 days after operation in un

TABLE VII.—RESULTS OF HEPARIN THERAPY FOR FROM 5 TO 7 DAYS AND OF DICUMAROL THERAPY ADEQUATE TO MAINTAIN A RATHER LOW PROTHROMBIN LEVEL FOR FROM 5 TO 7 DAYS

Method of treatment	Veins		Small Arteries				Large Arteries			
	Number transacted	Number thrombosed	Number transacted	Number thrombosed	Number transacted	Number thrombosed	Number transacted	Number thrombosed	Number transacted	Number thrombosed
Name	27	3	25		13	9	8		66	7
Heparin	26	5	6	1		9	7			8
Dicumarol	26		15		13	8	50	7	2	7.6

treated animals, animals treated with heparin for the same period, and animals treated for the same length of time with dicumarol in amounts sufficient to maintain the prothrombin level fairly constantly at about 30 per cent or less. Eighty five per cent of the veins were thrombosed in untreated dogs, 61.5 per cent in those treated by heparin and 46.2 per cent in those treated with dicumarol. The figures for small arteries are 92.9 per cent, 9.1 per cent, and 50 per cent, respectively and for large arteries 66.7 per cent, 11.8 per cent, and 17.6 per cent. There is no statistically significant difference in the incidence of thrombosis of veins and large arteries in the groups treated by heparin and dicumarol the incidence in small arteries is certainly significantly higher in those treated by dicumarol.

In Table VIII the incidence of venous thrombosis in untreated animals and in animals intensively treated with heparin and dicumarol for 24 or 48 hour periods is compared, the vessels being examined 24 or 48 hours after operation in all 3 groups. It will be seen

TABLE VIII.—COMPARISON OF INCIDENCE OF VENOUS THROMBOSIS 24 AND 48 HOURS AFTER OPERATION IN UNTREATED DOGS AND IN DOGS TREATED INTENSIVELY WITH HEPARIN OR DICUMAROL

Treatment	No. of veins transacted	No. of veins thrombosed	Percentage thrombosed
None	18	8	100
Heparin	45	7	5
Dicumarol	24	4	16

TABLE IX.—COMPARISON OF INCIDENCE OF THROMBOSIS 7 DAYS AFTER OPERATION IN UNTREATED DOGS AND IN DOGS TREATED WITH A SINGLE DOSE OF HEPARIN OR DICUMAROL

Treatment	Veins		Small Arteries				Large Arteries			
	Transacted No.	Thrombosed	Transacted No.	Thrombosed	Transacted No.	Thrombosed	Transacted No.	Thrombosed	Transacted No.	Thrombosed
Name	27	3	25		13	9	8		66	7
Heparin	6	10	8	1	20				10	3
Dicumarol	16		75						9	44.4

that while all of the veins in the control group were thrombosed only 15.2 per cent of those in animals treated with heparin and 16.7 per cent of those in animals treated with dicumarol were thrombosed. Obviously both drugs were effective but not statistically different from each other in value.

In Table IX the incidence of thrombosis 7 days after operation is compared in untreated animals, those treated with a single dose of heparin and those treated with a single dose of dicumarol. It is apparent that the anticoagulants given in this manner and this is particularly true of dicumarol had little demonstrable efficacy in lowering the incidence of venous thrombosis. In the control group 92.9 per cent of the small arteries were thrombosed in the heparinized group 10 per cent, and in those given dicumarol zero. It is apparent that a single dose of either anticoagulant lowered the incidence of thrombosis remarkably the results are not significantly different in the 2 treated groups. Sixty seven per cent of the large arteries were thrombosed in the control group 30 per cent in those given heparin and 44.4 per cent of those given dicumarol. Here, too, the anticoagulants appear to have resulted in a significant lowering of the incidence of thrombosis without a statistically significant difference in the effectiveness of the 2 agents.

COMPLICATIONS

Of 35 animals treated with heparin 25 or 71.4 per cent had evidence of subcutaneous hemorrhage. Of these 25 19 (76 per cent) had

all hematomas. Three or 12 per cent profusely at the time of operation that more of the vessels being sutured re- gation. Nine or 36 per cent of those there was bleeding died of postopera- tive hemorrhage.

dogs treated with dicumarol 11 or 44 bled subcutaneously. Of these 11 5 (45 per cent) had large 3 (27 3 per cent) small 2 (18 2 per cent) and 3 (27 3 per cent) small hema- tomas. None required ligation of the artery and none bled. Three or 27 3 per cent of the dogs which bled postoperatively died as the result of hemorrhage.

Within 3 menstruum heparin was given on more occasions to 28 dogs 16 or 57 1 per cent had some serious complication. Five (31 2 per cent) developed a slough at one or more of the sites of injection. Nine (32 1 per cent) had marked edema and inflammation in the thigh. Two (7 1 per cent) died of angrene.

DISCUSSION

analyzing the results of this study it is important to call attention to several facts. In the first place, in all the long term experiments heparin was given in amounts and at intervals which were generally inadequate to maintain a prolonged prolongation of coagulation time. In the second place, the clotting time tended to return to or near normal level before each subsequent injection of heparin. In this respect the technique employed was equivalent to the technique commonly employed in patients in which the heparin was given intermittently. For example, the intravenous administration of 50 milli- grams of heparin at 4 hourly intervals in man was usually attended by a highly fluctuating clotting time curve, the values rising sharply after each dosage and falling to a normal level before each new injection. In similar animal experiments in which dicumarol was used instead of heparin, the prothrombin values were kept at very low levels which are ordinarily considered dangerous in patients. In our analysis of the few exceptional experiments in which the prothrombin values were not kept at such a low level are segregated

and are not included in comparing the two anticoagulant agents. Thus in interpreting the results we must keep in mind the fact that the heparin effect was comparable to that generally considered safe in man, while the dicumarol effect was generally of a degree thought to be dangerous in man.

In the second place it should be emphasized that the experimental conditions of arterial and venous damage were of extreme degree. The arterial incisions were repaired in a fashion eliminating those details of technique known to foster a successful outcome. The veins were severely injured. Such extremes of trauma were necessarily adopted in order to achieve thrombosis consistently in most of the untreated animals. It must be borne in mind however that the effect of therapy was evaluated under more severe conditions of local vascular injury than are apt to be encountered in patients.

In the third place it would seem evident that any clinical application of the results of this study can be made properly without too much concern over the numerous hemorrhagic complications which were encountered. The persistent bleeding and the large hematomas which occurred all too commonly were generally due to hemorrhage from the line of suture of the repaired arteries. In experiments in which only the veins were traumatized significant hemorrhagic complications were very few. Since the arteries were deliberately sutured with purposeful disregard of principles which not only provide the best chance of successful healing but also give maximal insurance against leakage there is little wonder that control of bleeding was difficult in the presence of full anticoagulant effect. The recent experience of Shumacker, Ahramson and Lampert suggests that reparative surgery of peripheral arteries can be carried out safely in the presence of a full anticoagulant effect of dicumarol or heparin or of the two drugs in combination. Though hematomas were more common under such conditions than when anticoagulants were not used, careful observation of the patient and proper treatment precluded serious difficulties. It has become apparent on the other hand, that the immediate use of anticoagulants is

unwise when surgery is performed in the thoracic or peritoneal cavities or in other situations where bleeding may go unrecognized until the patient's life and the success of the operative procedure are jeopardized. The large recorded cumulative experience with heparin and with dicumarol in the treatment and prevention of venous thrombosis and embolic sequelae in man testifies to the relative safety of the drugs in these conditions provided the recognized means of control are carefully followed.

In comparing the efficacy of heparin and dicumarol in the prevention of venous thrombosis no significant difference was noted. This was true in experiments involving both a short or a more prolonged period of treatment. It seems unlikely that the comparatively equal effectiveness of the 2 drugs in the experiments involving a prolonged period of treatment is vitiated by the more intense and consistently maintained anticoagulant effect secured with dicumarol and the more intermittent, inconsistent prolongation of clotting time with heparin. In the experiments in which treatment was of one or two days' duration and in which a marked consistent anticoagulant effect was maintained in the heparinized dogs as well as in those treated with dicumarol no significant difference in the results was noted.

It is exceedingly difficult to be certain that any two groups of patients are adequately controlled in regard to important details such as local venous trauma, stasis, innate tendency to intravascular clotting etc. Nevertheless such large numbers have been treated with heparin and with dicumarol with comparably excellent results as to suggest that there is little to choose between them with regard to efficacy. To be sure, in the reported cases of patients treated with dicumarol the prothrombin time has generally been kept constantly at a fairly low level while in those treated with heparin the drug has been administered in a fashion recognized as inadequate for constant prolongation of clotting time. Whether contrary to our experimental studies, the results would be superior in patients treated with heparin in such a manner as to maintain consistently a prolonged clotting time, only further experience will reveal. Un-

less new experimental or clinical experiences throw a different light upon the subject, it would seem wise from the standpoint of economy and rapidity of action to begin treatment with adequate amounts of both heparin and dicumarol and to discontinue the heparin once a good prothrombin reduction has been achieved with dicumarol.

Our experiments demonstrated that thrombosis following sodium morrhuate trauma to veins occurs early there being as high a percentage of thrombosis in vessels inspected in 1 or 2 days as in those examined in 7 days. It is significant, however, that the prevention of thrombosis for the first day or so with adequate anticoagulant therapy does not preclude subsequent thrombosis once the treatment has been discontinued. It would appear that once the vein has been injured the best results can be obtained only if treatment is continued until healing of the vessel is complete.

In contrast to the results with venous injury our experiments showed the anticoagulants to be considerably more efficacious in preventing arterial injury and demonstrated an apparent inequality in the effectiveness of the two agents. If those animals treated with dicumarol in which the prothrombin level was not kept rather constantly low are omitted from consideration, there was no significant difference in the incidence of thrombosis in the larger arteries in dogs treated with the two drugs (15.8 per cent with dicumarol 9.5 per cent with heparin) but there was a much higher incidence of thrombosis of small arteries in those treated with dicumarol (50 per cent, as compared with 6.7 per cent). It must be recalled again that the prothrombin percentage was generally kept consistently very low in the animals treated with dicumarol and that the clotting time often rose to normal levels in those treated with heparin. No significant difference in thrombosis of arteries was noted a week after injury in dogs treated with a single dose of heparin or a single dose of dicumarol. In these experiments however the heparin effect lasted only a few hours while the dicumarol effect lasted for a day or more. Taking into consideration all of the experiments proper interpretation from the standpoint of clinical applicability is rather

difficult. Since arterial repair in man is ordinarily performed upon vessels as large or larger than the carotid arteries of dogs and since no difference was noted in the incidence of thrombosis of those vessels in dogs treated by heparin or by doses of dicumarol which were generally effective in keeping the prothrombin time very low one might reason that the two drugs should be equally effective in preventing arterial thrombosis in patients. Since our results were obtained however with heparin in doses comparable to those which are safe clinically and with doses of dicumarol resulting in prothrombin levels in the dangerous zone, one might on the other hand reason that if the two drugs are given in safe dosage better results might be anticipated with heparin. It is our opinion that this interpretation is probably correct. Furthermore maximal utility of an agent is often best evaluated under extreme conditions. There can be no doubt that heparin was more effective than dicumarol in preventing thrombosis of the small femoral arteries even though the former drug was generally given in doses inadequate to maintain constant prolongation of clotting time while the latter was given in amounts usually sufficient to keep the prothrombin percentage very low. Until further data are available it would seem wise to use heparin at least for the first 5 or 6 days in cases of arterial injury or repair. It would also appear wise to use dicumarol in conjunction with the heparin and to continue its administration until it is felt that all hazard of thrombosis is past. Our experiments do not provide an answer to the question as to how long the danger of thrombosis exists after arterial injury or repair. It has been the policy of one of us (HBSjr) arbitrarily to continue anticoagulants for 2 or 3 weeks after arterial repair.

Several other observations noted in the course of this study deserve brief discussion. In the latter part of the experiment we used the Kruse method for coagulation time and found it much more satisfactory than other methods. The blood can be obtained by pricking the skin; the temperature factor is controlled; the method requires less agitation of the tubes than does the Lee-White method; the end point is precise; the normal values are

shorter than those obtained with the Lee-White method and even when greatly prolonged are not so long as to exhaust the observer. Finally, it was found that the results could be checked with a smaller margin of error. It is felt that the method is deserving of more widespread trial.

The intravenous method of administration of dicumarol in basic solution was found most satisfactory. It has the advantage of precision of dosage and elimination of the variables of intestinal absorption. By its use the maximal effect is achieved more quickly than with oral administration. In hundreds of injections no instances of thrombosis of the injected veins were noted. It would appear profitable to pursue further the possibility of placing dicumarol in some solution suitable for clinical intravenous administration.

The Pitkin's menstruum used was similar to that employed by Loewe and his co-workers in their original work. It was found painful and was frequently followed by sloughing of the skin, massive edema and inflammatory reaction and occasionally by gas gangrene. It has the advantage of more prolonged action and cheaper cost than intravenously administered heparin. If the newer modifications prove to be devoid of distressing local reactions or should other efforts result in new means of administering heparin in some form which will produce a prolonged effect without local or general reaction, heparin therapy will be rendered easier, cheaper and more effective. Our experiments convinced us that if a constantly prolonged clotting time is desirable it can better be achieved by more frequent intravenous injection of small amounts of heparin rather than by giving larger doses at greater intervals. It has been inferred from certain clinical observations that heparin may be effective when given in doses and at intervals inadequate to maintain a constantly prolonged coagulation time. Our experiments tend to substantiate such inferences though they suggest that heparin is less effective in such dosage than in amounts which result in constant prolongation of clotting time. This problem is important and requires further intensive study. It will certainly be wise to study effects of heparin other than prolongation of clotting

time such as its effect upon platelet adhesiveness. Perhaps other manifestations of heparinization are evident after the clotting time has returned to normal

SUMMARY AND CONCLUSIONS

1 Experiments comparing the effectiveness of heparin and of dicumarol in the prevention of arterial and venous thrombosis following injury are reported.

2 Methods of producing experimental venous and arterial thrombosis are described.

3 Thrombosis following injury to the vessels appeared to occur early certainly during the first day or two

4 Under the conditions of the experiment, dicumarol and heparin appeared equally effective in reducing the incidence of venous thrombosis.

5 Under the conditions of the experiment, anticoagulant therapy was more efficacious in preventing arterial than venous thrombosis. Using doses of dicumarol adequate ordinarily to maintain a very low prothrombin level and

of heparin generally inadequate to maintain a constantly prolonged coagulation time, statistically superior results were obtained with heparin in preventing thrombosis of injured small arteries the results were not statistically different in preventing thrombosis in larger arteries.

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CARCINOMA OF THE PANCREAS

A Clinicopathologic Survey

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IN an attempt to survey and correlate clinical and postmortem findings in cases of neoplastic disease at Montefiore Hospital, it soon became evident that great confusion in diagnosis and profound differences between clinical impressions and postmortem findings were present in cases of cancer of the pancreas. We found that unless the patient exhibited jaundice the correct diagnosis was most often missed and unsuspected. Therefore it was decided to review all instances of cancer of the pancreas in which postmortem examinations were made from the years 1919 to 1946. One hundred and four cases were studied, which represented 3.8 per cent of all necropsies of neoplastic disease during this period. This incidence is higher than the figures of 1 and 2 per cent which are usually mentioned.

With improved methods in surgery of the pancreas, it is becoming more important today to recognize the syndrome of pancreatic malignancy early at a stage when radical operative treatment can be effected. Unfortunately except for cancer involving the head where jaundice may be present, the evidence on which such a diagnosis is based is often indirect. It is therefore, in cases of involvement of the body where the majority of errors in diagnosis are made. The poll of impressions by Berk is adequate testimony to this fact. In this poll which involved questioning of fourth year medical students, internes, residents, graduate students and general practitioners it was seen that 43 per cent of these younger and presumably better trained persons expressed the belief that painless jaundice was the most common and characteristic sign of cancer of the pancreas whereas 50 per cent stated that simple jaundice was the predominant feature many qualifying this by stating

that it was progressive. Only 2.5 per cent expressed the belief that pain was an outstanding symptom. A relatively insignificant number mentioned other important signs and symptoms such as weight loss, anorexia, gastrointestinal disturbances, enlarged gall bladder, deformed duodenum or diabetes.

For clinical considerations we think it best and most practical to divide cancer of the pancreas into two types: (1) cancer of the head and neck and (2) cancer of the body and tail. Chauffard in 1908 differentiated the two clinically by the terms '*pancreatico biliare*' for cancer involving the head and '*pancreatico solaire*' for that involving the body, the former based upon the jaundice, the latter upon the relation of the symptom of pain to the solar or celiac plexus. The clinical description of cancer of the head dates back to Bard and Pic who in 1888 described 7 cases proved by autopsy. They pointed out that the symptoms and signs characteristic of that condition were progressive, persistent, painless jaundice, dilatation of the gall bladder, clay colored stools and cachexia.

The wisdom of such a differentiation has been questioned by some. Berk, for example, stresses the unreliability of this distinction if one uses operative findings as criteria. He mentions that even at autopsy overlapping involvement of various parts of the gland is common and that small areas of involvement by extension from the dominant area may affect the clinical picture. Levy and Lichtman could find only 19 among 122 cases—diagnosed by laparotomy or necropsy—in which the body and tail alone were affected and they mention that even in these 19 there was terminal involvement of the head. Incorrect conclusions as to the primary origin can be made even at operation in spite of the fact that the head is palpated and biopsy taken from it. (4) Similarly Ransom's (26) experience with 10

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TABLE I—LOCATION OF TUMORS OF THE PANCREAS—104 CASES

Primary location	Total No. cases	Percent
A. Head and neck	57	54.8
Head only	43	
Neck only		
Extending into body	3	
B. Body and tail	43	4.3
Body and tail	5	
Extending into head	1	
Tail only	6	
Body only	1	
C. Aberrant pancreas	2	
Porta hepatis	1	9
Duodenum (first part)	1	
D. Islet cell		9
Body and tail		
Aberrant in liver	†	

*These cases are grouped with the carcinomas of the body and tail because the impression was that they arose primarily in the body.

†This case was published. See reference.

patients showed gross discrepancy between surgical and autopsy findings. The same holds true for differentiating at operation between cancer of the head of the pancreas and other cancers in that location which may produce jaundice such as cancer of the common bile duct or the ampulla of Vater. The diffuse involvement seen in some pancreatic cancers adds to the difficulties. However the above objections are concerned more with the difficulty of making the differentiation, especially in surgical material they do not argue against the validity of the principle. In our present material in which every case is verified by autopsy these objections do not hold. But even the differences in the autopsy findings have been questioned as being more apparent than real (18) the differences in tendency to extend and metastasize it is suggested may actually be due to a shorter course of the disease in cases of cancer of the head.

However predominance of the cancer in one part or the other of the pancreas is the rule rather than the exception. Not only do differences admittedly exist at autopsy but we feel that the clinical differences which manifest themselves are best understood by relating them to the various topographical areas of the pancreas. Therefore, we submit a clinical and pathologic analysis of our material which appears to indicate that an essential difference exists between the two types. In reviewing the histories which date back to 1919

TABLE II—LOCATION OF PRIMARY CARCINOMA OF PANCREAS (EXPRESSED IN PERCENTAGE)

Author	No. of cases	Head	Body and tail	Entire pancreas
Duff (9)	50	56	36	8
Kenney (20)	51	39	41	
Hick and Mortimer (17)	40	45	47	8
D'Amico Ogden and Halpert (7)	40	75	3	
Levens (21)	57	62	30	30
Graesser (16)	34	44	3	41
Our series	104*	57	33	11

*The two aberrant and islet cell tumors are not listed in the percentage column.

we must admit of some difficulties in gleanings statistical clinical data since they were taken by many different observers. In most cases involving the body and tail with the diagnosis unsuspected during life, certain pertinent x ray and laboratory studies were often missing.

The distribution of our 104 cases according to the primary location of the tumor is shown in Table I. In reviewing the autopsy series in the literature, a large variation is seen in respect to the relative percentage incidence of involvement of the head, as compared with that of the body and tail. This is indicated in Table II. In this table the series of Duff (9) of Kenney and of Hick and Mortimer agree most closely with our findings in that carcinoma of the body is nearly as frequent as that of the head. There is some confusion as to where the cases involving the entire pancreas should be placed. Heretofore most of these have been included with the carcinomas of the head. We feel that this is not justified, for in our series the autopsy findings as well as the clinical picture pointed to the body and tail as the primary site. In comparing autopsy with operative series, it should be noted that the latter always include a high incidence of cases with jaundice and thus have a tendency to exaggerate the percentage incidence of carcinoma of the head. For reasons just mentioned it is felt that the diagnosis of carcinoma of the body has been relegated to the back ground too often and that this condition occurs more frequently clinically than is appreciated. A more exact localization of the primary site of these tumors, both at opera-

TABLE III — SEX INCIDENCE IN CARCINOMA OF PANCREAS

	Male	Female	Total
Head and neck	39	18	57
Body and tail	16	17	43
Aberrant pancreas	1	1	2
Islets of Langerhans	1	1	2
Total No. of cases	67	37	104

tion and necropsy would lead us to a clearer understanding of the clinical picture.

Age and sex incidence In Table III the sex incidence is shown in the total number of cases in those involving head and neck and in those involving the body and tail. This table illustrates that there is a predominance of males affected, in a ratio of 1.8 to 1. This ratio of males to females however is somewhat greater in carcinoma of the head 2.2 to 1 and somewhat less in carcinoma of the body 1.5 to 1.

Chart 1 represents graphically the age incidence of this form of carcinoma. The peak of incidence of carcinoma of the head and neck occurs between 51 and 60 years whereas that for carcinoma of the body and tail occurs between 56 and 65 years.

Duration of illness Chart 2 represents an analysis of the life span in our cases. The graph indicates that the maximum incidence of death in cases involving the head and the neck of the pancreas was between the 4th and 6th month after symptoms appeared whereas that in cases involving body and tail was between the 10th and 12th month after onset. In some of the autopsy series showing comparative statistics wide variations are found. Grauer's cases show the widest variation including cases with survival ranging from 1 month to 7 years. In Duff's (9) series comprising 16 cases involving body and tail the average

TABLE IV — FREQUENCY OF PAIN, JAUNDICE AND WEIGHT LOSS IN CARCINOMA OF THE HEAD OF THE PANCREAS* (EXPRESSED IN PERCENTAGE)

Name	No. of cases	Pain	Jaundice	Weight loss
Franco (14)	40	85	78	60
Friedenwald and Morrison (15)	40	82	77	—
Zollinger and Kevorkian (30)	40	77	86	86
Rigney (28)	40	62	—	65
Our series	57	68	90	90

*These figures are based upon the incidence in the later stage.

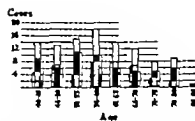


Chart 1 Age incidence in carcinoma of pancreas. White areas, total number of cases; black areas, carcinoma of head and neck; crosshatched areas, carcinoma of body and tail.

duration of illness was 4.2 months, although one case of 19 months duration is not included. Among the 16 cases of carcinoma of the head which he reports the average duration is 4.6 months essentially the same as for those involving the body. More statistical information is necessary before conclusions can be drawn in regard to survival. The difference in duration which our cases seem to show may possibly be explained on the basis that carcinoma of the head interferes more with the vital functions of the pancreas, the liver and the biliary system by virtue of obstruction of the main duct systems.

CANCER OF THE HEAD AND NECK

From the standpoint of early diagnosis, the initial picture of the disease is of utmost importance. An attempt was made to analyze in our cases the earliest signs and symptoms. Chart 3 presents in the order of their incidence the signs and symptoms noted initially and later in our series of 57 cases expressed in percentages.

Table IV indicates comparative figures found in the literature for the main symptoms of pain, jaundice and weight loss. As may be

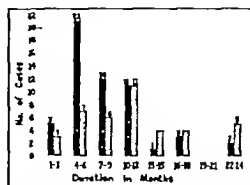


Chart 2 Survival time in carcinoma of head and body of pancreas compared. Black areas, head; crosshatched areas, body.

†A few cases at the extremes are omitted from the graph.

TABLE V—JAUNDICE IN THE EARLY AND LATE STAGES OF CANCER OF THE HEAD (57 CASES)

A. Early phase		No. cases
1. Jaundice alone as first sign		8
2. Jaundice concomitant with other signs and symptoms		3
Painless	8	
Painful	4	
3. No jaundice		43
4. Palpable gall bladder		4
B. Late phase		
1. Jaundice		3
Painless	6	
Painful	35	
2. No jaundice		6
3. Palpable gall bladder		1

seen from this table there is a relatively close degree of correlation.

Weight loss The incidence of 65 per cent weight loss initially as indicated in Chart 3 stresses its importance. The amount of actual loss in our cases was not always stated, but there were frequent references to the fact that it was marked and rapid. In those cases in which figures were available, it ranged from 6 to 60 pounds depending upon the time it was first noted. The average finding was a loss of 8.3 pounds per month.

In the autopsy protocols, emaciation was specifically mentioned in 23 out of these 57 cases.

Pain In 49 per cent, as Chart 3 indicates, pain was one of the first symptoms to appear. It was second only to weight loss in its frequency and much more common than jaundice. Vague distress and discomfort were not included as manifestations of pain. In the later stages of the disease, the incidence of pain rose to 68 per cent. Since, in that stage, the incidence of jaundice was 90 per cent, it is obvious that in a small number of cases the jaundice was painless.

Jaundice Chart 3 indicates that jaundice was a presenting sign in 25 per cent, and a late sign in 90 per cent. In 10 per cent, there was no clinical jaundice at any time. Table V indicates the relationship between the jaundice—the stage of the disease and other concomitant findings. In the 37 cases where jaundice appeared late there was a delay in its occurrence ranging from 1 to 43 months. Leaving out two extremes, one of 43 months, the

other of 30 in order not to weight the average, the delay was 3.8 months. Distended gall bladders were noted clinically in approximately one fourth of the jaundiced patients. Itching was present in 3 cases, in 1 before the onset of jaundice.

At autopsy jaundice was present in 34 cases as compared with the 57 cases in which it was noted clinically. This difference is explained by various operative procedures used to short circuit the biliary flow. However anatomic obstruction of the distal portion of the common bile duct was found at autopsy in 80 per cent of 57 cases, slightly less than the late clinical incidence of obstructive jaundice, 90 per cent. It has been noted by some (8) that obstructive jaundice may exist in the presence of a patent common bile duct, and this is suggested to be due to the lack of expulsive or contractile ability of the common duct by reason of invasion of its nerve supply or its wall by tumor. Obstruction of the distal portion of the common bile duct was associated with dilatation of the proximal bile passages in 38 of the 57 cases. In 28 of these, the gall bladder was also dilated. As noted previously in Table V only 12 of these 28 distended gall bladders were palpated clinically. There was intrahepatic bile stasis in 23 cases. In only 6 was this associated with biliary cirrhosis, in 7 with cholangitis. As a corollary of this, the pancreatic duct was dilated in approximately 50 per cent.

Shortcircuiting operations for relief of jaundice Since many of the jaundiced patients had shortcircuiting operations we compared the operated upon and nonoperated upon groups with respect to duration of life. Fifty cases were suitable for analysis. 30 patients had been operated upon. 20 had not been operated upon. The figures obtained were as follows: The onset of illness to onset of jaundice in nonoperated upon group was 3.8 months. In operated upon group 3.5 months. The onset of jaundice to death in nonoperated upon group was 3.5 months. In group operated upon 6.3 months. The total duration of illness in nonoperated upon group was 6.7 months. In group operated upon 9.8 months.

There was 0.6 month average delay between appearance of the jaundice and opera-

tion in the group operated upon. It appears from the figures that these short-circuiting operations prolonged life an average of 2.8 months.

Anorexia Anorexia was present as an initial complaint in 44 per cent. Although it is difficult to differentiate anorexia from various gastrointestinal disturbances, among which nausea and consequent loss of appetite would be prominent, it was mentioned specifically as such, in the histories concerned and we felt it was repeated often enough to bear distinction.

Weakness Weakness was noted in 35 per cent as an initial finding. It is an expected associate of anorexia and weight loss.

Gastrointestinal disturbances and obstruction In our 57 cases there were 15 or 26 per cent which showed various gastrointestinal disturbances in the initial stages. These included vomiting, diarrhea, constipation, epigastric distress, fullness, discomfort, cramps, belching, etc. As seen in Chart 3, 14 per cent of our cases, or more than half of those exhibiting initial gastrointestinal complaints, had some degree of high intestinal obstruction in the early stage of the disease. This finding was later verified by x-ray examination in 6 cases. Thus, in the earliest phase 11 per cent had positive x-ray evidence of high obstruction. In the later stages of the disease, a total of 79 per cent exhibited either obstruction or distortion in the pyloroduodenal area. Twenty-five cases, or 44 per cent, had the clinical picture of high intestinal obstruction, varying from partial to complete; of these 16 were proved by means of the x-ray and 3 at operation, while 6 were clinically diagnosed and later proved at post-mortem. On fluoroscopy and roentgenography of upper gastrointestinal tract 20 cases or 35 per cent had some distortion of pyloric end of stomach or the duodenal bulb although they had no obstructive symptoms or signs. Of these latter cases, 11 involved mainly the antrum of the stomach, and 9 the duodenum.

A deep epigastric mass was palpated in 33 per cent of the cases in the later stage. None was felt initially. Hematemesis or melena or both were present in 9 cases or 16 per cent. In 2 cases tarry stools were presenting symptoms.

At autopsy there were 11 cases with partial duodenal and 1 with pyloric obstruction in

Symptom	Percentage	Symptom	Percentage
Weight loss	48 %	Weight loss	36 %
Pain	49 %	Nausea	30 %
Anorexia	44 %	Vomiting	24 %
Diarrhea	23 %	Epigastric distress	24 %
Constipation	24 %	High intestinal obstruction	14 %
Weakness	35 %	Stomach Army Enlargement	35 %
High Obstruction	14 %	Epigastric Mass	33 %
Partial Army End Intest.	11 %	Palpable Gall Bladder	21 %
Palpable Gall Bladder	7 %	Metastatic Hematemesis	20 %
Metastatic Hematemesis	7 %	(Extra-luminal)	
Belching	5 %	Metastatic Hematemesis	16 %
Melena	4 %	Diarrhea	10 %
Diabetes	1 %	Stool-terrors & Cramps	7 %
		Hypertrophic Stomach	4 %
		Diabetes	4 %
		Periph. Hematemesis	4 %
INITIAL		LATE	

Chart 3. Signs and symptoms of carcinoma of the head, initial and late—57 cases.

the total of 57 cases. There were 5 gastroenterostomies. In addition to these cases of frank obstruction, there were also 21 instances in which the tumor had invaded the wall of the duodenum and 3 the wall of the stomach without obstruction. As Chart 3 indicates, a higher incidence of obstruction was noted clinically but it should be remembered that only anatomical and not functional obstruction is seen at the autopsy table. With respect to intestinal bleeding, ulceration of the duodenum was present in 4 cases at post-mortem. In the remainder there was no obvious cause for the bleeding. However, portal obstruction whether by thrombosis, invasion or compression by tumor could produce intestinal bleeding as the result of congestion even in the absence of varices.

Hepatomegaly In 2 cases a large irregular liver was an initial sign; however, hepatomegaly was a much more prominent feature later in the disease and was present in 58 per cent, or 33 cases. Of these 15 were merely classified as large livers, 18 as irregular. The latter were clinically assumed to be metastatic.

At autopsy, metastatic lesions were found in the liver in 32 cases. In addition there was direct invasion of the liver in 1 case and extension to the porta hepatis in 4.

Metastases Chart 3 indicates that in 4 cases (7 per cent) metastases were responsible for the first signs and symptoms. These 4 cases were metastases to the skin in 1, large irregular livers in 2, and persistent diarrhea in the other. The latter finding was shown to be due to implantation of tumor on the ileum (post-mortem). In the final stages 11 or 19 per cent

TABLE VI.—INCIDENCE OF PAIN WEIGHT LOSS AND ANOREXIA IN CARCINOMA OF THE BODY OF THE PANCREAS* (EXPRESSED IN PERCENTAGE)

Name	No. of cases	Pain	Weight loss	Anorexia
Ransom (35)	16	100	94	9
Duff (9)	6	94	90	
Our series	43	98	98	28

*These figures are based upon the incidence in the later stage.

of the cases exhibited clinical evidence of metastases (excluding hepatomegaly). These were found in the late stages in the following sites: 3 in the pelvic peritoneum (Blumer's shelf), 2 in the lungs (x ray), 1 in the ribs, and another in the supraclavicular nodes.

At necropsy 10 of the 57 cases, or 18 per cent, exhibited no metastases.

Diabetes. Diabetes occurred in 2 of these cases. In both it was associated with chronic pancreatitis (autopsy). In 1 of the cases, it appeared with the presenting signs and symptoms.

Peripheral edema was seen in 2 cases.

Ascites was present clinically in 10 per cent and at autopsy in 28 per cent.

Steatorrhea and cretorrhea were present in 7 per cent in the later stages of the disease. The incidence of these findings is much smaller apparently than the incidence of pancreatic duct obstruction for at necropsy 50 per cent of the cases of carcinoma of the head exhibited dilatation of the pancreatic ducts. Fibrosis and atrophy of the body and tail were present in over half of these.

Errors in diagnosis. Diagnostic errors were made in 13 of these 57 cases. They were as follows: 6 were diagnosed as carcinoma of the stomach; 2 without jaundice were unsuspected of having cancer; 1 was diagnosed as coronary or gall-bladder disease; 1 as carcinoma of the ampulla of Vater; 1 as carcinoma of the gall bladder; 1 as biliary cirrhosis, and 1 as metastatic carcinoma of the liver; primary site unknown.

CANCER OF THE BODY AND TAIL

The 43 cases of cancer of the body and tail of the pancreas as classified in Table I were surveyed. The first presenting signs and symptoms are listed in Chart 4.

The frequency of some of the main complaints in this series is compared in Table VI with the series of Ransom (35) and Duff (9) and it is seen that there is fairly close agreement.

Pain. The figures in Chart 4 and Table VI emphasize the importance of pain in the clinical picture. It was uniformly severe and was present as an initial complaint in 70 per cent of our cases and later in 98 per cent.

Weight loss. Weight loss was about as prominent in the initial picture as pain. In our series of 43 cases 72 per cent gave this as a first complaint, and it was often noted as "rapid" and marked. It varied from 10 to 60 pounds, the average loss being 6.6 pounds per month. Emaciation was specifically noted in the autopsy protocols in 44 per cent.

Weakness was noted in about 41 per cent initially and progressed throughout the illness.

Anorexia was noted as an early symptom in 29 per cent, and was persistent.

Gastrointestinal disturbances and obstruction. Excluding anorexia, gastrointestinal disturbances were noted in 14 cases, or 33 per cent initially. Seven had constipation alone; 6 had generalized abdominal cramps and distention; 3 had diarrhea and 7 had nausea and vomiting. In the later stages of the disease these non-specific complaints rose to an incidence of 67 per cent, second only to pain in frequency. As in carcinoma of the head, a part of the complaints just enumerated can be attributed to obstruction by compression or invasion or both of the pyloroduodenal region by the tumor. Chart 4 indicates that high intestinal obstruction was exhibited in 6 cases, or about 14 per cent, as a presenting symptom; later the incidence rose to 37 per cent. These findings are similar in magnitude to those found in cancer of the head. Low intestinal obstruction was present in 7 cases, or 16 per cent, and only in the late stages. This was due either to extension of the process to the large bowel or to serosal metastatic implants. This type of obstruction and spread was not seen in cancer of the head.

An epigastric mass was noted clinically in only one case at an early stage, and is thus not an important presenting sign. However, a mass presumably the primary tumor deep in

the epigastrium or in the left upper quadrant, was felt in the later stages in 35 per cent, an incidence comparable with the 33 per cent found in cancer of the head.

On x ray examination 5 patients in the initial and 15 in the later stage exhibited some degree of pyloric or duodenal or both pyloric and duodenal distortion or obstruction. Of the latter 15 cases 9 involved the stomach only, 3 the duodenum only, and 3 both. Thus in findings were present in 35 per cent of the cases similar to cancers of the head and neck.

Hematemesis or melena or both were seen in 4 cases or 9 per cent, as presenting symptoms 1 bad hematemesis all 4 bad tarry stools. Adding to these 4 the cases in which bleeding occurred later there was a total of 7. Of these 7 or 14 per cent 3 bad hematemesis in addition to melena.

At autopsy 2 cases of pyloric obstruction and 3 cases of intestinal obstruction were found, the former caused by invasion of the stomach wall the latter by metastases. Three other cases showed invasion of the stomach wall, 14 had metastases to the intestines and 22 had diffuse peritoneal carcinomatosis all these failed to produce frank obstruction. The high percentage of distortion compression and displacement of the stomach and duodenum found on x ray examination may be explained by the fact that carcinoma of the body and tail has a tendency to invade the surrounding soft tissues and to fuse with the perigastric and peripancreatic lymph nodes to form large tumor masses. This was found at postmortem in 13 of our 43 cases.

Hepatomegaly Enlarged livers were found in a total of 25 cases or 58 per cent, a figure comparable to that seen late in cancer of the head. Of these 25, 11 were recorded as smooth 14 as irregular and definitely metastatic.

Anatomic findings showed the liver to be involved in 30 cases either by metastases or by direct extension.

Splenomegaly This was present clinically in 5 cases or 12 per cent in 1 case there was direct extension of the neoplasm to the spleen in 2 cases there was associated ascites. There was no splenomegaly noted clinically in the cases of cancer of the head.

Signs and symptoms	Percentage	Signs and symptoms	Percentage
Weight loss	72%	Pain (Weight loss)	67%
Feat	70%	Abnormal Testes	67%
Headache	42%	Abnormal Lungs	60%
Pyrosis/Gastric	33%	Abnormal Heart	58%
Intestinal Distortion	33%	Hepatomegaly	58%
Ascites	28%	Ascites	40%
Metabolic Disturbances	23%	High Obstruction	37%
High Obstruction	34%	Ab Low Intestine	35%
Headache	32%	Pyrosis/Melena	33%
Diabetes	2%	Diabetes	33%
Hematemesis & Melena	9%	Low Obstruction	36%
Pyrosis/Melena	2%	Peripheral Edema	36%
Edema	2%	Hematemesis & Melena	14%
Jaundice	0%	Splenomegaly	12%
		Jaundice	7%
		Stomatitis & Constipation	0%
	INITIAL		LATE

Chart 4. Signs and symptoms of carcinoma of the body initial and late—43 cases.

At autopsy, 5 instances of splenomegaly were found associated with carcinoma of the body 2 with carcinoma of the head 12 per cent and 4 per cent, respectively. The main reasons for the splenomegaly were compression invasion or thrombosis of the splenic vein.

Diabetes The association of diabetes with involvement of the body and tail was remarkable. There was a total of 14 instances of diabetes in our series of these 4 existed prior to and 4 coincided with the onset of the presenting symptoms, whereas 6 cases developed during the course of the disease. This is in marked contrast to the low incidence found in cancer of the head where it was present in only 2 cases, both with chronic pancreatitis. A much higher incidence of disturbances in carbohydrate metabolism would be present if the cases with temporary glycosuria hyperglycemia or with abnormal glucose tolerance curves were included.

Metastases As seen from Chart 4 metastases were already present as initial signs and symptoms in 10 cases or 23 per cent as compared with 7 per cent for the head. In the later stages metastases (extrahepatic) were found clinically in 26 cases or 60 per cent, in contrast to the 12 per cent found in the comparative stage of cancer of the head. This is consistent with the pathological findings. In 11 of these 26 cases exhibiting metastases, there was no associated enlargement of the liver in the remainder hepatomegaly was present. Table VII enumerates the types of clinical metastases noted above in both the initial and later phases in terms of the site of involvement.

TABLE VII.—SITE OF METASTASES NOTED CLINICALLY IN INITIAL AND LATE PHASES OF CARCINOMA OF THE BODY AND TAIL (43 CASES)

Site	Early	Late	Total
Intestine (intestinal obstruction)	5	4	9
Skin	2	1	3
Liver	6	14	20
Pleura and lungs	1	4	5
Spleen			2
Rectal shelf	0		10
Vertebrae	0	6	6
Epididymis and testis	0	2	2
Ovaries and uterus			1
Breasts	0		1
Lymph nodes	0	2	2
Omentum			1

As expected the incidence of metastases at autopsy was much higher than that seen clinically. The metastatic lesions found at post mortem and the remarkable difference in the extent between those seen in carcinoma of the head and neck and those of the body and tail are best illustrated in Table VIII. It is pertinent to note that at autopsy only 2 cases or 5 per cent of these 43 showed no metastases whereas in cancer of the head 10 of the 57 or 18 per cent were free of spread. The difference in the invasive qualities of each type is also illustrated in Table VIII.

Ascites. There was an incidence of 40 per cent of ascites as compared to the 10 per cent found in cancer of the head. Ascites was typical of the later stage. In 5 cases it was of the chylous type. In every case some other type of metastasis was already evident.

At autopsy ascites was present in 51 per cent of carcinomas involving the body and only in 27 per cent of those involving the head, an incidence somewhat higher than that found clinically.

Thrombosis and peripheral edema. Chart 4 indicates that peripheral edema was noted in 1 case in the initial stage and in 7 cases or 16 per cent, later. In 1 case thrombosis was suspected clinically. In only 2 cases was the edema associated with ascites. This incidence of 16 per cent peripheral edema as compared with 3 per cent for the head may be significant and will be referred to in the discussion.

At autopsy thrombosis of blood vessels was associated with 12 cases or 21 per cent of the carcinomas of the head and with 15 cases, or

33 per cent of the carcinomas of the body. Disseminated thrombosis was not present in the former (head) whereas in the latter (body) 2 such instances were noted. The location of the thrombi were as follows: in the carcinomas of the head the portal circulation was involved in 3 cases, the systemic circulation in 9, in the carcinomas of the body the portal circulation in 5 cases and the systemic in 10. Six additional cases of carcinoma of the pancreas came to autopsy in 1946: 3 involving the head, 3 the body. Thrombosis of blood vessels was present in 3 of these cases (1 carcinoma of the head and 2 carcinomas of the body). In 2 cases (1 head, 1 body) thrombosis was widespread.

Jaundice was present in 3 cases but only in the late stage. In 1 case it was due to extension of the tumor to the head, in another to associated ascending cholangitis, and in a third to metastatic involvement of the liver. These findings were confirmed at autopsy.

ISLET CELL CARCINOMA AND CARCINOMA OF ABERRANT PANCREATIC TISSUE

Two islet cell carcinomas were found in our 104 cases. Both were functioning and widely metastasizing tumors. One originated in aberrant pancreatic tissue in the region of the porta hepatis and was reported from this hospital (1). The other occurred in a 46 year old white female who complained of weight loss, anorexia, periumbilical and back pain with abdominal distention of 1 year's duration when she first sought medical advice. At that time, an enlarged irregular liver and a strongly positive guaiac reaction in the gastric contents were found. It was remarked that during a gastrointestinal x ray examination she suffered a fainting spell. The diagnosis of metastatic carcinoma of the liver was made, primary site unknown. Six months thereafter and 1 month prior to her death she was admitted to our hospital where for the first time fainting spells were recognized as attacks of hypoglycemia. Hepatosplenomegaly, ascites, and metastatic lymph nodes were found. In this case as well as the other quoted the alkaline phosphatase was elevated—there was no jaundice in either case. At autopsy, an islet cell carcinoma of the body and tail of the pancreas with widespread metastases was found.

Three carcinomas in aberrant pancreatic tissue were found in our series 1 of them has been referred to and was classified in Table I as islet cell carcinoma. A second case was a 53 year old male whose illness started 1 year before death with symptoms of 'neuritis' in his right shoulder 2 months later, he began to complain of sharp epigastric pain, unrelated to the digestive cycle. This pain was relieved by sitting up and leaning forward and was not relieved by an ulcer regimen. X ray examination of the gall bladder and intestinal tract was negative. At exploration "an adenocarcinoma of the pancreas with metastases to regional lymph nodes" was diagnosed. Later an epigastric mass and venous thromboses in the upper extremities appeared. At autopsy an adenocarcinoma in aberrant pancreatic tissue at the porta hepatis with extensive metastases was found. A third case was an 80 year old white female, who began losing weight a year prior to her death, and who 9 months later developed signs and symptoms of high intestinal obstruction. The clinical diagnosis entertained was gastric malignancy. At autopsy adenocarcinoma of aberrant pancreatic tissue originating in the second portion of the duodenum was found.

DISCUSSION

From the clinical and pathological data just presented it seems justified to divide carcinomas of the pancreas into two types (1) carcinoma of the head and neck and (2) carcinoma of the body and tail.¹ It is further indicated that there is a much greater relative incidence of carcinoma involving the body than has been heretofore realized, and that the statistics have been unduly weighted by jaundice misdiagnosis and other factors in favor of carcinoma of the head. Of our cases 55 per cent involve the head of the pancreas and 42 per cent the body, 2 cases of carcinoma of aberrant pancreatic tissue and 2 islet cell carcinomas are included among these 104 cases.

Certain differences in sex and age incidence and survival are indicated with respect to involvement of the different areas. In general the incidence of carcinoma of the pancreas is

TABLE VIII.—SITE OF METASTASES AND INVASION NOTED PATHOLOGICALLY IN CARCINOMA OF THE PANCREAS (EXPRESSED IN PERCENTAGE)

A. Site of metastases	Head and neck	Body and tail	B. Site of invasion	Head and neck	Body and tail
Metastases absent	17.5	5	Liver	3	0
Lymph nodes	52	60	Stomach	5	11.6
Liver	54	60	Spleen	0	0
Spleen	3	21	Porta hepatis	7	3
Intestines	13	33	Kidney	0	5
Gall bladder	3	2	Adrenal	2	0
Peritoneum (isolated)	10	14	Common bile duct	20	0
Peritoneum (carcinoma tole)		51	Duodenum	35.6	0
Lungs—pneum	22	35	Transverse colon	0	3
Adrenals	12	37	Blood vessels	0	30.5
Kidneys	7	14	Base of mesentery	11	0
Ureters		2			
Uterus	0	2			
Ovaries	3	14			
Heart	5	5			
Thyroid	3	5			
Bone	3	5			

twice as high in males as it is in females but this ratio is greater in carcinoma of the head and less in carcinoma of the body. It further appears that the peak age incidence for the head occurs somewhat earlier in life (51 to 60 years) than that for the body (56 to 65 years). As to survival the peak incidence of death in cases of carcinoma of the head occurs between 4 and 6 months while that in carcinoma of the body occurs at 11 months. Shortcircuiting operations for the relief of jaundice in carcinoma of the head appear to prolong life a few months.

In these 104 cases there were wrong clinical diagnoses in 23 per cent of the cancers of the head and in 84 per cent of the cancers of the body indicating the great difficulty in diagnosing the latter. The misdiagnoses encountered in carcinomas of the head were given above, but those entertained in carcinoma of the body were so varied as to defy classification they ranged from a diagnosis of cord tumor or arthritis of the spine, to cancer of the stomach. In not a few cases, functional diag-

¹ Henceforth referred to as carcinoma of the head and carcinoma of the body.

noses were entertained. It is not the intention here to minimize the difficulty but to emphasize it and to focus the attention on the pancreas when vague but suggestive and persistent symptoms of the types described present themselves.

Observations on Signs and Symptoms

Weight loss Rapid weight loss for some reason not entirely clear is distinctly characteristic of cancer of the pancreas. It is reasonable to assume that lesions in an organ concerned with vital intestinal functions such as the splitting and assimilation of foodstuffs would be reflected in a great lowering of the nutritional status. This would seem to be especially applicable to cancer of the head where the entire biliary and pancreatic secretions would be blocked. In our cases it was highest in incidence in the early stage in both types. Rapid weight loss, unaccounted for by other disease such as diabetes, tuberculosis or hyperthyroidism, should arouse a suspicion of pancreatic cancer especially if associated with upper abdominal or back pain. Ingelfinger (18) calls attention to the frequency and importance of weight loss and mentions that this may indicate advanced disease and preclude operability if the body is involved. However for reasons already mentioned, this is not necessarily so in cancer of the head.

Pain Pain was twice as frequent as jaundice as an initial symptom in carcinoma of the head and it increased in incidence as the disease progressed. The classical description of 'painless jaundice' should be modified; it has been perpetuated perhaps because in the differential diagnosis of "obstructive jaundice" the chief interest is in distinguishing between a stone in the cystic or common duct and cancer. Since the former usually produces a severe colic which is excruciating to the extreme, it has been the habit in teaching to relegate the pain of cancer in this region to an insignificant position. If the emphasis were placed more upon the differentiation between the two types rather than the presence or the absence of pain it would be more correct. The pain may not be as immediately intense as the colic of a stone or as prominent a feature as it is in cancer of the body where it is unique, but it

is quite often severe and persistent. It is dull pressing burning aching or boring. It may occasionally simulate biliary or intestinal cramps if it is located in the upper abdomen, usually epigastric and frequently towards the right, and may radiate to the right back and scapular region. Its similarity to ulcer pain and its possible confusion with that condition has been noted (14, 16). The pain does not easily fit into any common pattern and is unrelated as a rule to the digestive cycle.

In carcinoma of the body pain is the outstanding and unique feature of the disease. It is intense, fairly constant, but may be intermittent. It is located deep in the epigastrium or in the back in the lower dorsal or upper lumbar region and often radiates around the lower chest and upper abdomen in girdle-like fashion involving the left hypochondrium and sometimes the lower thoracic segments. It may spread to the epigastric and periumbilical areas. It may be dull boring or sharp and is unrelated to the digestive cycle. The back pain is often the major complaint and is the reason for misdiagnoses such as cord tumor. In its most characteristic form this pain is relieved by sitting up and leaning forward and aggravated by lying down. Thus it is especially troublesome at night and causes the patient in many instances to assume a characteristic position sitting up, bending forward, with lower extremities flexed upon the abdomen in a squatting Indian fashion. Pain is presumably best explained by pressure of the tumor on the celiac plexus, which is intimately related to the posterior surface of the gland. Ransom (25) gives an excellent description of its characteristics in his 16 cases. A study of the neoplastic invasion of nerves and its possible clinical significance in relation to the pain has been made by Drapiewski. Another explanation mentioned for the pain but probably a less likely one is obstruction of the pancreatic duct. The occasional similarity of the pain to that seen in peptic ulcer is possibly explained by ulceration of the tumor through the mucosa of the stomach or duodenum.

Jaundice is not an early sign of carcinoma of the head. Dunphy noted that in 40 per cent of the cases seen at Peter Bent Brigham Hospital there was a delay of several weeks to

several months before jaundice appeared. This agrees with our observations. Actually it is only in the rare case where jaundice alone gives the needed and early clue. In carcinoma of the body, jaundice is absent except late in the disease when it may occur due to extension to the head or metastases.

Gastrointestinal disturbances and obstruction Gastrointestinal complaints of a nonspecific nature figure prominently in the symptomatology of both types of involvement. A good share is attributable to high intestinal obstruction due to pressure on, or invasion of the pyloroduodenal region by the primary tumor; this complication is much more frequent than is realized and is characteristic of both types of involvement, with a similar incidence in each. Low intestinal obstruction is not uncommon in carcinoma of the body.

The occasional incidents of gastrointestinal bleeding, hematemesis or melena or both presumably occur from extension of tumor through the mucosa, either at the primary or metastatic site or from interference with the portal circulation as mentioned previously.

Metastases In some cases metastases cause the presenting signs and symptoms; this occurs 3 times more frequently in carcinoma of the body than in carcinoma of the head. These facts indicate that early stages of pancreatic malignancy may unfortunately be asymptomatic. Wide and diffuse metastatic lesions are typical of carcinoma of the body; relatively infrequent in carcinoma of the head. These differences in spread are possibly due to differences in position and topography of the two sections of the organ, the body being much less encompassed by surrounding structures and rather devoid of covering except for a thin layer of peritoneum on its ventral surface. At postmortem examination 18 per cent of the cases of carcinoma of the head were free of metastases as compared with only 5 per cent for that of the body. It is to be hoped that these cases will henceforth receive the chance for radical surgery and cure.

Disturbances in carbohydrate metabolism The remarkable association between carcinoma of the body and tail and diabetes was already mentioned. Berk, although he does not attempt to differentiate between head and body

or different stages of the disease, reviewed the incidence of 'diabetic' manifestations in the literature. He found glycosuria in 9.4 per cent, hyperglycemia in 19.4 per cent, and impairment of glucose tolerance in 17 per cent of the various series reviewed. He himself examined 9 cases for abnormalities in glucose tolerance, and found them in 7. He therefore considers these tests of great diagnostic importance. Diabetes and disturbances in carbohydrate metabolism are found in a high percentage of cases of carcinoma involving the body and tail. They are infrequent in carcinoma of the head. This is expected since the majority of the islets of Langerhans are located in the body and tail. This difference is well exemplified by our material.

Diabetes has been projected as a predisposing cause of cancer of the pancreas. It has been reported by McKittrick and Root and Marble (23) that 32.4 per cent and 13 per cent respectively of all cancers in the diabetics they studied involved the pancreas, since the comparative figures for the nondiabetic population are 1 to 3 per cent; these figures are striking. Those of McKittrick and Root are based upon 37, and Marble's on 256 malignancies which developed in a large group of diabetic patients. In the former group the onset of diabetes antedated the onset of the pancreatic malignancies by an average of 3.6 years, and in Marble's group by 2.4 years. Marble noted that this interval was shorter in carcinoma of the pancreas than in any of the other malignancies. This latter fact would seem to reinforce the significance of this association. In our series 9 per cent of the patients with carcinoma of the body had pre-existing diabetes. In Berk's own cases without distinction as to type of involvement, there was an incidence of 11.7 per cent and 6.9 per cent was present in a series of 275 cases he reviewed.

Thrombosis and edema It is noted in our material that the incidence of peripheral edema, though this is only presumptive evidence of thrombosis, is much higher in carcinoma of the body than in that of the head. The finding of frequent multiple venous thromboses in cases of carcinoma of the body of the pancreas has been noted by many observers (13, 20, 29). Sproul in 1938 impressed by this associ-

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ation studied the problem and found that of all types of malignancy venous thromboses were most frequently associated with this type of pancreatic involvement. In her series of 49 cases involving the pancreas, she noted an incidence of 9.7 per cent of widely disseminated venous thromboses in tumors involving the head as compared with 31 per cent for those involving the body. She suggested that pancreatic cancers modify in some way the blood clotting mechanism. Kenney arrived at similar conclusions in 51 cases of pancreatic cancer where he found no multiple thromboses in cases involving the head, and 33 per cent in those involving the body. He urges study of all factors concerned with the clotting mechanism in these cases. It should be kept in mind that carcinoma of the body of the pancreas may first manifest itself by peripheral venous thrombosis.

Ascites Ascites was found clinically 4 times as frequently in carcinoma of the body as in carcinoma of the head; in a few it was chylous in character. Since generalized abdominal carcinomatosis and venous thromboses are much more typical of carcinoma of the body this finding is not unexpected.

Steatorrhea and creatorrhea. In this series of cases approximately 7 per cent of the carcinomas of the head were noted clinically to exhibit steatorrhea or creatorrhea or both. However this figure cannot be used as a true indicator of the frequency of disturbances in fat and protein absorption since stool studies were not done in many of the cases. It is probably true that these exist in greater degree in cases of involvement of the head, since here a small lesion may block the pancreatic duct and exclude the secretion from the intestinal tract, whereas massive involvement of the body would be required to reduce the production of pancreatic juice to a comparable degree. Berk reviewed the literature in regard to stool fat content and concluded that less than 10 per cent exhibit steatorrhea.

Aberrant pancreatic tumors Aberrant pancreatic tissue is more common than is generally realized. Faust and Mudgett reported on 370 cases gleaned from the literature, 1 of which was their own. Their analysis of the distribution of aberrant pancreatic tissue showed that

it was most frequently located in the duodenum, 30 per cent, and in lesser degree in other locations, such as stomach, jejunum and ileum. Other unusual sites were mesentery, omentum, gall bladder and spleen. Duff and associates (10) found an incidence of slightly over 1 per cent in 1970 autopsies. It is recognized that both benign and malignant tumors may originate in aberrant pancreatic tissue, and they are often confused with primary tumors in the region involved.

Laboratory aids It is pertinent to remark upon the value of laboratory and x ray studies in the diagnosis of cancer of the pancreas. Defects in carbohydrate metabolism may be present and as already mentioned are more frequent in cancer of the body and tail. Study of the pancreatic enzymes may offer some clues. Johnson and Bockus stated that hyperlipemia was observed in over 50 per cent of 30 patients with pancreatic carcinoma at some stage of the disease. A high value is significant; a low value does not rule out the disease since in the later stages the destruction of pancreatic tissue will reduce the concentration of all the enzymes both in the blood and in the intestine. Serum amylase has also been studied, but the results are more equivocal. Comfort and Osterberg determined both, and they mentioned that serum lipase was elevated in 40 per cent and amylase in only 8 per cent of their cases. Studies of the duodenal secretion of pancreatic enzymes have been made, with and without stimulation by secretin and mecholyl; in some cases, diminished volume of secretion and diminished concentration of both pancreatic enzymes and bicarbonate may be noted. This method of study by duodenal intubation should be useful in differentiating between jaundice due to intracholedochal pathology and that due to involvement of the head of the pancreas by cancer, since in the latter both biliary and pancreatic juices would tend to be diminished. Jaundice may be followed and studied by the usual laboratory procedures. Steatorrhea and creatorrhea, if found, are strongly suggestive of pancreatic disease but a high percentage of negative findings may be expected. Split fats may be found in the intestinal tract without the presence of pancreatic juice either be-

cause of the action of the intestinal juices or the bacterial flora upon the ingested fats. Even in the absence of external pancreatic secretion, practically normal fat digestion and absorption may still go on. Excess fat or nitrogen excretion is best determined by quantitative diet and stool studies. Average values for normal individuals being 1 to 3 grams per day for fecal nitrogen and 10 to 15 grams per day for fecal fat. Figures for fat excretion based upon percentage of dry weight on single stool specimens with patients on an uncontrolled diet are too variable. In pancreatic achylia a marked increase of fecal volume is often found. In 1 case of total pancreatectomy reported by Ricketts and associates, the fecal volume increased from the 150 to 200 grams found normally to 1500 to 1800 grams. Occult blood in the stool is an occasional finding. A moderate anemia irrespective of blood loss, is usually found as is an increase in the sedimentation rate.

X-ray and fluoroscopic examination of the upper gastrointestinal tract may be very helpful. Distortion, displacement and obstruction usually of an extrinsic nature reflected upon the stomach and the duodenum are frequently present. The obstruction and distortion produced by cancer of the head usually involves the pylorus and the entire duodenum, the normal curve of which may be widened and distorted. Cancer of the body usually displaces the stomach upwards and forwards and distorts the pylorus and the proximal duodenum.

A battery of these laboratory and x-ray studies and familiarity with the clinical picture will no doubt enhance the diagnostic accuracy.

Clinical and pathological differences. Since it has been our contention that pancreatic cancer should be divided into two syndromes it would be proper in the final paragraphs of discussion to tabulate these differences briefly in a general fashion. Although many cases show overlapping in clinical symptomatology, Table IX shows schematically the more frequently seen differences.

The clinical differences noted in Table IX were generally confirmed at autopsy. The conspicuous pathological features of carcinoma of the pancreas are as follows: emaciation,

TABLE IX—CLINICAL DIFFERENCES IN INVOLVEMENT OF THE HEAD AND BODY OF THE PANCREAS

Signs and symptoms	Head	Body
Pain	Epigastric and right sided. Less severe and less frequent	Epigastric, left sided and back pain. Severe and almost universally present
Jaundice	Present in most cases	Absent
Diabetes	Infrequent. Sugar tolerance disturbances also infrequent	Diabetes and sugar tolerance disturbances frequent
Ascites	Infrequent	Common
Metastases	Few clinically	Diffuse and widespread
Thrombosis and edema	Not frequent	More common (especially disseminated thrombosis)
Splenomegaly	Rare	More common
Stenorrhoea and crepitation	Occasionally present (10%)	Less frequent
Laboratory findings	Likely to have serum lipase elevation	Less likely to have serum lipase elevation
X-ray defects	Reflected in pyloric area and first, second and third parts of duodenum	Reflected in stomach and first portion of duodenum

ascites, hard tumor invasion of adjacent structures, invasion of blood vessels and a tendency to thrombosis. A distinctive feature of carcinoma of the head is obstruction of the common bile duct with jaundice. Distinctive features of carcinoma of the body are invasion of nerves and a tendency to widespread metastases.

SUMMARY

1. One hundred and four cases of carcinoma of the pancreas were analyzed from the clinical and anatomic points of view.

2. The early and late clinical manifestations were described and correlated with the anatomic findings.

3. The material indicates the advisability of separating the syndromes of pancreatic cancer into 2 main groups: (1) those affecting the head and neck and (2) those affecting the body and tail of the pancreas. The clinical and anatomic differences observed in both groups are described and discussed.

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TRANSPLANTATION OF PERONEUS LONGUS TO ANTERIOR TIBIAL INSERTION IN POLIOMYELITIS

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TENDON transfer to replace and substitute for the function of a paralyzed muscle was first performed by Nicoladini in 1882. He attempted to replace a paralyzed tendo achillis by means of the peroneals. Later Lange in 1900 used silk strands to lengthen tendons and Vulpius recommended suture of the transferred tendon to the tendon of the paralyzed muscle. Biesalski in 1910 recommended intrasheath transplantation in order to avoid the complication of adhesions preventing the gliding of tendons which had been a cause of failure in many of the cases reported by Lange and Vulpius. Mayer and Biesalski subsequently reported in their treatise the results of work proving the value of intrasheath transplantation based upon prolonged study of tendon anatomy and physiology.

Transplantation of the peroneus longus as practiced at the New York Orthopedic Dispensary and Hospital follows the method of Biesalski and Mayer. The admonitions of Peabody and Ober should be studied and remembered or tendon transplantation will not be as successful as would otherwise obtain. In a few cases the transplantations have been done by subcutaneous passage of the transplanted tendon without detracting from the result but for the most part the technique has been as follows with the patient under general anesthesia and an Esmarch tourniquet being used: a 1.5 inch incision is made over the lateral aspect of the foot extending from the peroneal tubercle of the os calcis to the base of the fifth metatarsal. The peroneus longus tendon is identified and divided as far distally as possible. (At this point in the operation Mayer advises suture of the distal tendon to the cuboid to act as a check ligament on the first metatarsal and to help prevent dorsal flexion of the first metatarsal segment with resulting dorsal bunion.) The incision is closed temporarily and a second incision 2 inches long is

made over the medial aspect of the foot at the insertion of the anterior tibial tendon. The tendon sheath is opened the tendon split longitudinally and a trap-door hinge distal is created in the medial cuneiform. This incision is then temporarily closed. A third incision 4 inches long is made over the middle third of the anterolateral aspect of the leg. The skin and subcutaneous tissues are dissected medially and laterally from the deep fascia. The superficial sensory branches of the peroneal nerve are identified and preserved. The deep fascia is incised longitudinally over the tendon of the peroneus longus and over the anterior tibial extending slightly proximal to the musculotendinous junction. Short transverse incisions are made at upper and lower ends of the incisions through the deep fascia thus creating two fascial flaps whose far edges are sutured together everting the under surfaces and creating a gliding membrane over which the peroneus longus may be passed. The peroneus is then drawn from the first into the third incision and is passed into the second incision through the sheath of the anterior tibial lying obliquely across the gliding surface made from the fascial flaps. The cut end of the peroneus longus is carried into the trap door in the medial cuneiform with the foot in a corrected attitude and in a position of right angle flexion. In this position it is sutured under physiological tension. The tendon is sutured to bone and to the tendon of the anterior tibial which is pulled proximally under moderate tension. All incisions are then closed in layers. A plaster-of-paris bandage is applied from toes to tibial tubercle maintaining the ankle at 90 degree dorsiflexion.

This study is based on 31 cases of transplantation of the peroneus longus tendon to the anterior tibial insertion in cases of poliomyelitis. The operations were performed at the New York Orthopedic Dispensary and Hospital during the period from July 1 1934

to January 1, 1944. Twenty-one patients have been available for end result study. The follow-up period on those 21 cases ranges from 8 months to 7 years 9 months, with an average follow-up period of 4 years. There were 18 males and 14 females. The age at operation varied from 4 to 35 years with 20 cases in the age group 12 to 19. Of these 21 patients followed a grading of excellent has been given in 33 per cent of good in 38 per cent of fair in 10 per cent, and of poor in 19 per cent. Of the 19 per cent classified poor all 4 cases were dynamic failures and patients either have a residual fixed pronation deformity of the first metatarsal or have had to have ankle fusion performed for complete foot-drop. The 2 cases classified as fair show a residual foot drop gait only with fatigue and a passive first metatarsal drop without an active deforming element. They have no symptoms referable to either residuum. The differentiation between excellent and good, representing a combined percentage of 71 is based principally upon actual strength of the transplanted muscle. Those called excellent have strong transplants in well balanced feet. A good classification is applied to cases in which the transplanted muscle is fair to good in strength and there is no muscle imbalance. These classifications therefore might be criticized to some extent but we were primarily interested in function both of transplanted muscle and of the foot and not solely with actual strength of the transplanted muscle. In addition residual deformity and tendency to recurrent deformity received considerable attention. When residual deformity is absent or present only at rest and when tendency to recurrent deformity has been eliminated, at least a fair rating must be given irrespective of the actual strength of the transplanted muscle.

At the present time, this operation is not done without triple arthrodesis having been performed beforehand. In the past, 8 patients in one of whom the operation was performed on both feet, had transplantation without arthrodesis preceding it. Three of these patients subsequently had to have arthrodeses to correct postoperative varus deformities. One other had an arthrodesis to correct varus but when the tendon was re-

transplanted to a more lateral position the result was a failure and ankle fusion was performed for foot-drop. None of the patients who had arthrodeses first developed subsequent varus deformities, a factor which could be taken to signify an increase in strength in the anterior tibial secondary to re-enforcement by a well functioning transplant. We have had some misgivings about doing this operation in patients with some residual power in the anterior tibial because it has been noted that occasionally the anterior tibial increases in strength in the patients who are treated by transplantation of the extensor digitorum longus to the mid foot. It was feared that this increase in strength might occur in these cases and cause a varus deformity. The peroneus longus transplantation is never done, therefore, when any amount of power remains in the anterior tibial. Since the anterior tibial and peroneus longus muscles are antagonistic in their action upon the first metatarsal segment re-enforcement of the former by transplantation of the latter is definitely contraindicated. The relative strength of both extensor and flexor hallucis longus muscles should also be considered. One patient now presents a dorsal bunion and dorsally flexed first metatarsal segment following transplantation of the peroneus longus in the presence of a strong flexor hallucis longus and a paralyzed extensor proprius hallucis.

The postoperative fixation period varied from 3 to 10 weeks with a mean of 5 weeks. Our opinion about this part of the treatment has been revised. We now feel that with anchorage of the transplanted muscle into bone we can safely begin 'setting' exercises at 3 weeks after operation. Patients have their plaster boots bivalved and should wear the posterior shell at all times. Exercises are given with the shell in place and are carried out daily. At the end of an additional 2 weeks they should be able actively to dorsiflex the foot easily from the position of right angle dorsiflexion. They are then ready for ambulant activity in a brace.

In a paralytic foot with absent or very weak tibialis muscles the fundamental deformity is valgus, either static or dynamic or both. More important than this, however is the forefoot

cannot be done with absolute certainty. Observation of a foot in active eversion and testing the resistance of a foot in this position is the first step. Attempting passive dorsal flexion of the first metatarsal segment plus palpation of the individual tendons proximal and posterior to the lateral malleolus yields additional information to one who is accustomed to testing and grading muscle strength. The remaining extensor muscle strength should also receive close consideration and in the absence of good strength in the extensor proprius hallucis and extensor digitorum longus, transplantation of both peroneals should be the chosen procedure. This latter muscle, namely the peroneus brevis, being unsuitable for intrasheath transplantation can be so placed as to effect a lateral balance of power in the previously stabilized foot.

The postoperative management of these cases especially of the more recently performed operations have borne out the importance of proper postoperative training. Any transplant is not as strong as the normal muscle and therefore should be protected by suitable apparatus and strengthened by careful graded exercises. This latter should be continued until one is satisfied that the transplanted muscle is capable of performing the work required of it. Three patients seen at the New York Orthopedic Hospital Outpatient Clinic and 2 patients seen elsewhere have been noted to have little demonstrable power following discharge from the hospital—this meant usually 5 weeks of fixation, 2 to 4 weeks of physical therapy and exercises in the hospital and at home for a varying period. On examination no response could be elicited in the transplanted muscle except with cajoling and considerable effort on the part of the patient and examiner. With an intensive program of carefully planned physical therapy within 3 weeks function was markedly improved. Two methods of exercising these transplanted muscles have been used: (1) active dorsiflexion exercises until peroneus comes into action; (2) graded instruction and use of peroneus as an evorter along with exercises for dorsiflexion. The patient attempts eversion and dorsiflexion as a combined measure. This seems to call upon the peroneus longus as it would have

functioned in its original position as an evorter. Since the insertion has been changed one readily established an association between dorsiflexion and eversion resulting in peroneus longus function as a dorsiflexor because of its altered insertion. In simple dorsiflexion exercises however no active effort is made by the peroneus and re-education fails. The method embodying a combined motion seems the more logical.

Since the re-establishment of function in this transplant is difficult and painstaking in recent cases patients have been fitted with ankle braces. These serve a dual purpose acting to protect the transplanted muscle from postural stretch and from the dynamic influence of a strong calf. In cases in which heel cord lengthening has been done brace protection has been routine at the New York Orthopedic Hospital. The addition of another catch to the ankle brace serves to protect the transplanted muscle as well. The re-education of those patients who have had the benefit of brace protection has been more rapid.

In the consideration of treatment of paralytic valgus differentiation of the static from the dynamic deformity or from a combination of both must be made. It is in the purely static type of deformity that stabilization alone yields excellent results. A combination of the two types of deformity requires usually both stabilization and transplantation of tendons. Without the latter procedure, recurrence of deformity even in the presence of a firm bony fusion of the subtalar and midtarsal joints is the result. At the same time one must realize that removal of the deforming force of an unopposed peroneus longus even though the resulting strength of the transplant is not good, is still to be considered a good result since we have produced a foot stabilized in a good attitude for function without a deforming tendency. This might be said to be a good negative result as opposed to a good positive result in which the transplanted muscle is strong. This fact of course, must be considered in studying the end result. It is in this type of foot that the patient may note no remarkable change. The transplant, however, must be considered at least fair by reason of the negative result.



Fig. 1. left. Active dorsiflexion of foot in which peroneus longus is overactive and anterior tibial is paralyzed, showing the pronation of first metatarsal segment.

Fig. 2. Pronation of first metatarsal segment as seen from lateral side of foot. Muscle imbalance clearly demonstrated here.

The equinus element of this deformity is variable depending upon the extent of the extensor muscle paralysis and the strength of the calf. Upon this will depend the success of transplantation of the peroneus longus. The presence of marked extensor paralysis militates against the success of the simple transplant. The presence of calf contracture also defeats the transplant for two reasons (1) increased tension in the transplanted muscle which becomes greater with the contracture of the calf (2) a dynamic as well as static influence in presence of marked extensor weakness and a strong calf.

The transplant failed to function in 4 cases and these 4 patients had marked calf contracture. Five patients had a calcaneal tendon lengthening at the time of transplantation and in only one was the strength of the trans-



Fig. 3. Two postoperative views of same foot after triple arthrodesis and peroneus longus transplant showing restoration of muscle balance and active dorsiflexion without dynamic deformity.

planted muscle not good. The other 4 had very strong active transplanted muscles. Most of the patients with residual calf contracture of 10 degrees or more showed less actual strength in the transplanted muscle than was noted in the group without calf contracture. Some of these had no treatment of the heel cord shortening because it exerted a beneficial effect upon a weakness at the knee. Here, of course a negative result was accepted in order to preserve the function of the extremity as a whole. If however the knee is stable of itself calf contracture should be carefully considered and treated at the time of transplantation. Lengthening of the tendo achillis adds much to the operative result and does not increase the surgical risk.

One may question the judgment in cases selected for transplantation in which calf weakness plus a weakness of dorsiflexion obtained with or without a sufficient quadriceps weakness to make for an instability at the knee. At least 7 patients were discovered with this dis-



Fig. 4. Preoperative roentgenogram showing lateral view of foot at rest. The first metatarsal pronation is clearly indicated.



Fig. 5. Postoperative roentgenogram showing correction of first metatarsal pronation by triple arthrodesis and first metatarsal osteotomy as indicated by arrow.

crepancy of whom one required after operation stabilization of the knee by a brace. Two other patients felt they were no better because the calcaneus element of the limp was not improved. Those patients with sufficient calf power to limp only slightly at a slow gait noted real improvement when drop-foot was eliminated but the group with a loss of calf strength sufficient to make an unsightly calcaneal limp were disappointed with the results of their operations. This group and those with knee instabilities might have been better with pantalar arthrodesis and a consequent functional take-off from the ball of the foot. These patients, of course do not have the potato-foot deformity usually seen in severe calcaneus and although the entire extremity requires further stabilizing procedures a definite tendency to recurrent deformity has been removed and the function of the foot has been improved thereby. Since ankle fusion is undertaken usually at a later age it behooves us to establish lateral muscle balance without deforming tendency to a foot which has already shown progressive deformity. We can then await a definite demonstration of functional inadequacy of the extremity before proceeding with additional stabilizing surgery. Even though ankle fusion may be necessary in the future this latter procedure does not alter the condition of imbalance and will not prevent redevelopment of deformity. These patients will still develop the huge callosity under the first metatarsal head with symptoms from this. They will also show a progressive recurrence of a pronation deformity of the forefoot.

The alternate procedures available to us in cases requiring ankle fusion are resection of a portion of the peroneus longus tendoo or tenotomy to obtain the negative result without attempting to gain the 'positive' result.

These procedures have not been performed at this hospital. When this is done however one must be absolutely certain that the patient cannot get along without a brace and without ankle fusion. Many times this may be a moot question. Transplant followed by a long period of observation therefore, makes itself the procedure of choice. Certainly if we can leave the patient with a stable extremity in which ankle motion still obtains, it is incumbent upon us to do just this.

The following recommendations seem indicated in treatment of these patients

- 1 Careful preoperative muscle grading
- 2 Attention to calf contracture.
- 3 Stabilization of the foot preoperatively correcting all fixed deformity at this time
4. Improvement in the technique of transplantation
- 5 Shortening of the period of absolute fixation to 3 weeks.
- 6 Postoperative brace fixation until the transplant demonstrates maximum obtainable power
- 7 Careful postoperative physical therapy
- 8 The end result may be a good 'negative' result in which progressive deformity has been checked or a good 'positive' result in which the transplanted muscle is strong and the foot well balanced

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TUMORS OF THE BREAST

Preoperative Roentgenography

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MEDICAL propaganda has been effective in bringing more patients to the doctor early in the course of their disease. This opportunity for the recognition of early tumors is a challenge to the medical profession that must be met by improvement in diagnostic methods. Concerning the breast, except for a recent suggestion that radioactive isotopes (11) may be helpful in the early diagnosis of cancer, nothing new has been developed since the introduction of transillumination (2) and roentgenography (3, 9, 10, 12, 13). Until a definite method of diagnosis becomes available roentgenography would seem to merit better appreciation as an aid in the clinical diagnosis of mammary disease.

GENERAL CONSIDERATIONS

The roentgen diagnosis of breast abnormalities is extremely difficult. It requires meticulous technique and considerable experience. In no way is it a substitute for a careful history and a painstaking physical examination.

A complete roentgen study comprises examination of both breasts and axillae. This makes possible detection of metastatic lymph nodes as well as the primary lesions in the breast. Whereas metastatic axillary nodes are often felt with ease many that remain unrecognized by palpation can be demonstrated roentgenographically. Metastatic malignant axillary nodes often are sharply defined and stand out more clearly than those enlarged from other causes.

In the breasts, the skin has a different density than the subcutaneous fat. The veins traversing the subcutaneous and fatty portions of the breast are demonstrated easily. The interfascial plane between the base of the breast and the pectoral muscles can be disclosed. Elements of the suspensory ligament which divide the subcutaneous layer cast a dif-

ferent shadow in the roentgenogram than does the surrounding lipid tissue. Fat is an excellent contrast medium for the glandular and stromal structure of the breast so that the more fat in a breast the easier it is to demonstrate mammary structure. This is fortuitous since it is the fat breast which offers the greatest difficulty to clinical examination.

The uncertainty presented by abnormal roentgen mammary patterns is not so much their detection as their interpretation. As to detection obvious limitations are apparent the most important being the earliest stage of cancer which can be appraised. When is cancer 'early' and what criteria for diagnosis at this early stage can be found acceptable to pathologist, clinician and roentgenologist alike? A cancer cell *in situ* may be as much a cancer cell as one out of bounds. Not only cannot pathologists agree on this but clinicians too generally will not allow that a cancer cell *in situ* comes under the heading of disease. There are those who maintain—and not without reason—that a cancer cell which has not broken through its normal confines cannot be classified as disease. It is within the realm of possibility that many initially formed cancer cells while still *in situ* are either desquamated like normal cells or destroyed by the body's protective mechanisms before they break through their limiting membranes. Since the demonstration of cancer cells even in rather large cell aggregates is most difficult for the roentgenologist except in fatty breasts, it concerns him little if the pathologist argues about cancer cells *in situ* as the first stage of cancer. This stage of the disease is far earlier than can be detected by any roentgen means so far devised. It therefore, follows that the earliest changes identified roentgenographically would be those modifying the mammary architecture as the result of infiltration and proliferation by large cell masses.

In the compact nonfatty breast of the adolescent and the thin nonlactating breast of the adult normal as well as abnormal infiltration can occur on a large scale without roentgen manifestations. This is complicated manyfold by the wide variations in breast patterns that normally exist among breasts in different healthy women. To this must be added the difficulties which arise because of the physiologic changes that occur in breasts of the same woman during adolescence, the menstrual cycle, the menopause and in the postclimacteric period. In spite of this pleomorphism it is encouraging to note how often early abnormal changes in mammary architecture can be appreciated by roentgenologists proficient in this field.

The next hurdle, however, is more difficult. What use is the recognition of abnormal shadows in the breast if their meaning is not discernible? To this end thorough familiarity with the physiology of the breast, the symptoms of its diseases as well as a good history and physical examination are of paramount importance. Even then unequivocal conclusions can be reached in but a small proportion of cases (4).

The greatest satisfaction in routine roentgenography of breasts for the diagnosis of early cancer stems from that small group of cases, possibly less than 10 per cent, in which both the clinical examination and transillumination have failed. This group includes primarily patients with large fat breasts in which the glandular and stromal structures are recognized easily and where localized infiltrates out of bounds in the fat tissues become apparent readily to the roentgenologist. In such instances the surgeon is furnished crucial information of which he may not have been aware. This is always a greater triumph for the roentgen technique than the mere confirmation of the presence of a tumor or nodule previously detected by the patient or the clinician (Fig. 1).

While in rare instances radiologists discover a tumor mass lying deep in the breast that is protected from manual palpation by a thick pad of overlying mammary or lipoid tissue, the majority of roentgen examinations merely confirm the presence of abnormal nodules or

infiltrates found clinically. This confirmatory evidence, however, has distinct value. In addition to delineating the pathological structures with a preciseness not possible by clinical examination, a permanent record is secured which can be used for comparative studies during the progress of the disease (Fig. 2).

Various methods have been used for visualizing the ductal system of the breasts with opaque media. These have made possible the recognition and biopsy of intraductal abnormalities, but the methods are painful and tedious. They require a great deal of skill and experience and carry the constant threat of infection. Only when a positive microscopic diagnosis of malignancy is established can these procedures be regarded as reliable (6, 7, 8). Pneumomammography also has been used by radiologists and surgeons in an effort to increase their diagnostic acumen. Air, oxygen or carbon dioxide injected interstitially under pressure serve as adequate contrast substances, but the value of the procedure has yet to be established (5).

THE BREAST WITH A SINGLE TUMOR

When a single lump in the breast is found by the patient or her physician, the prime objective of the roentgenologist is its visualization. When the patient states that the lump varies in size from time to time, the breast can be checked at intervals when the patient believes these changes to be most pronounced. Confirmation of these changes is fairly good evidence of a nonmalignant lesion, one which may be due to trauma, infection or more usually a functional endocrine disturbance. On the other hand, when there is evidence that the lump has been enlarging progressively or that the nipple or skin has become retracted, one examination will suffice. No matter what is observed in the film, the lesion is apt to be malignant. A detailed account of the manner in which a nodule has grown, therefore, is extremely important.

In the roentgenogram, the lack of sharpness of the margins and the irregularities of contour are the crucial findings that differentiate the malignant from the benign processes. Benign lesions usually have spherical smooth outlines (Fig. 3). It cannot be denied that a



Fig 1a



Fig 2a.



Fig 1b



Fig 2b.

Fig 1. Anaplastic carcinoma. A lump was felt in the opposite breast by the patient 4 days before medical consultation. The x-ray films disclosed nothing abnormal but in the symptomatic breast, an irregularly outlined mass about 1.5 centimeters in diameter was visible in the roentgenogram, a, and the diagnosis of probable malignancy was based on the irregularity of the margins of the lesion. The microscopic studies, b, revealed the presence of an anaplastic carcinoma.

single discrete movable and circumscribed nodule with no retraction of the skin even in a young woman may prove to be a highly ma-

Fig 2. Scirrhous carcinoma. The opposite breast had been removed 5 years previously after a diagnosis of carcinoma had been established. The patient noted a small lump in this breast 1 week before the x-ray examination, a. The lesion was demonstrated easily because of its location in the fatty tissues. The irregularity of its margins suggested malignancy which was confirmed by microscopic examination, b, of the tissue as scirrhous carcinoma.

lignant cancer. It is also true that a ductal carcinoma cannot be differentiated from a fibroadenoma if there has been no effect on the nip-

ple or overlying skin. Nor can a carcinomatous infiltration which has undergone cystic degeneration be differentiated from a benign cyst merely by the sharpness and smoothness of the outline and contour. The final diagnosis in such cases rests on the findings of microscopical study of the section (1). Irregularly outlined lesions caused by localized benign nodularity must be distinguished from a single discrete malignant tumor. A collection of cysts in cystic mastitis, early multiple fibroadenomas and papillomas cannot be differentiated easily from a localized nodular cancer. The roentgenographic method offers one the opportunity of determining malignancy by studying the outlines of a tumor but the diagnosis is often inconclusive. A suspicious carcinomatous infiltration might then be checked by re-examination later. Here again care in eliciting a careful history can be of the utmost importance (Fig. 4).

THE MULTINODULAR BREAST

The difficulties attending the proper roentgen interpretation of a single mammary tumor are compounded in the multinodular breast. Since there exists a diffuse form of cancer which can mimic a benign multinodular infiltration the greater chances of diagnostic error must be recognized.

In the fat pendulous breast the branches of the suspensory ligament which insert into the skin may become quite dense and divide the subcutaneous fat layer into lobules. This type of false multinodularity is recognized easily in the roentgenogram if not by palpation.

In thin subjects with little or no fat a diffuse nodularity can be palpated which is due to extension of glandular elements into the bases of the branches of the ligaments suspensoria. Since the average breast is covered by a layer of fat ranging from 1 to 4 centimeters in thickness this nodularity is demonstrated often more easily roentgenographically than by palpation.

Another form of multinodularity is encountered in women who have borne children. After lactation involutional atrophy of the acini always is greater than that of the ducts which then must become convoluted to accommodate themselves to the smaller area of

atrophied breast. This produces a diffuse nodularity and is another form which can be seen usually in roentgenograms when not appreciated by palpation.

The multinodularity caused by cystic mastitis does not have the symmetrical distribution that characterizes the breast lesions already mentioned. In this condition the nodules usually are not the same size and their distribution is irregular. Cysts must be many millimeters in diameter before they can be demonstrated by roentgen methods. Large cysts are readily discernible in fat breasts even when they escape palpation.

Finally some rare forms of carcinoma produce a diffuse nodularity which is usually either bilateral or symmetrical but which almost always involves the skin retracting or distorting it by the pull of the infiltrations into the bases of the suspensory ligament. These changes can be seen by inspection usually easier than in the x ray film.

THE RADIOLOGIC AND SURGICAL RELATIONSHIP

Until some specific test is developed for the diagnosis of early carcinoma of the breast, every diagnostic procedure now available should be employed. Among these, the roentgenographic approach cannot be omitted even though its field of usefulness is limited. Not only would it seem advisable that its use be part of every routine examination of the breast, but also that its use should be part of every preoperative procedure. This is particularly true of the survey examination of the lungs and the skeleton. Those with experience are aware how often the absence of mammary findings is associated with the presence of metastatic regional lymph nodes or more distant metastatic foci elsewhere in the body. The radiologist not infrequently wonders whether the bone metastases he finds some months after mastectomy were present before the operation. There is a small but well recognized group of highly malignant carcinomas of the breast in which the first sign of the disease may be caused by a metastatic deposit. These deposits may be palpated in the axillary nodes or revealed only after x ray examination of the bones. A spontaneous fracture of a bone or



Fig. 3a



Fig. 4a



Fig. 3b



Fig. 4b.

Fig. 3. Cystic mastitis. This patient felt a lump in the right breast 3 weeks after delivery. Moderate irregular multinodularity was palpable in both breasts and a smoothly contoured mass in the right breast about 5 centimeters in diameter was visible in the roentgenogram, a. This mass was removed and the microscopic examination, b, of the tissues revealed the presence of cystic mastitis.

Fig. 4. Adenocarcinoma. This patient felt a lump in her breast over a period of several weeks with slight increase of its size. Roentgenologic examination a, disclosed a small irregular mass with no retraction of the skin. A mastectomy was carried out and the microscopic study b, which was made of the tissues revealed the presence of an adenocarcinoma.

pain in the spine due to metastasis may occur as the initial sign in rare instances

In cases in which a doubtful appraisal of a mammary mass has resulted after all diagnos-

tic measures have been exhausted and it is unfortunate that this occurs in many cases a local exploratory operation or mastectomy would seem indicated without delay. While

the radiologist may have found one or more lesions that were not recognized by physical examination and while by their shape and contour he might have been led in his opinion to favor the diagnosis of a benign process it must be conceded that the chances of error are greater than the dictates of safety allow. Under such circumstances, prompt biopsy cannot be avoided. If the consensus favors a benign lesion simple biopsy usually is safe and sufficient. If the suspicion of malignancy exists then frozen section with arrangements and permission for proper surgical management cannot be delayed.

SUMMARY

Roentgenography of the breast has much to recommend its routine use in the diagnosis of mammary disease especially in the diagnosis of early malignant processes. Small malignant lesions in fat breasts often can be demonstrated when their presence is not otherwise suspected. Abnormalities and other diseases of the breast also can be studied and while there are limitations to accurate diagnosis these limitations can be reduced by better acquaintance with the roentgen examination.

The malignancy or benignancy of a growth occasionally can be determined by its roentgenographic appearance but when this is impossible the surgeon is furnished additional data by which to direct his surgical procedure. A survey x ray examination of the chest and skeleton might well be recommended before operation for all patients suspected of having malignant disease.

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NEUROVASCULAR COMPLICATIONS FROM MALPOSITION ON THE OPERATING TABLE

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THE sequelae of malposition on the operating table are often of serious consequence. Previously, we have discussed respiratory and circulatory embarrassment resulting from improper positions on the operating table (10). This paper is devoted to some of the neurovascular injuries which occur either with, or independently of the other physiological disturbances.

In most cases neurovascular injuries are preventable. Although such injuries are relatively infrequent they occur more often than is suspected. Awareness and foresight in the prevention of these complications is preferable to therapy however effective after the injuries occur.

Nerve paralyses following anesthesia were observed shortly after the advent of ether narcosis (1-6) and were attributed by some to the toxic effects of the anesthetic agent (7). It was soon learned, however, that these injuries were associated with the position of the patient on the operating table.

Although numerous articles were written about the year of 1900 with adequate and detailed explanations of the etiology these preventable injuries have continued to occur.

The principal factor in such injuries is ischemia resulting from stretching or pressure on the nerve (3-4). The experimental work of Denny Brown demonstrates the mechanics and the pathology of this trauma. He points out that pressure for even a few minutes may cause impaired nerve function. The effects of pressure on nerve function are graded as of four degrees: (1) no effect; (2) paralysis with rapid complete recovery on release of pressure; (3) paralysis with delayed recovery without degeneration; and (4) complete anatomic lesion with degenerative phenomena.

During anesthesia if muscle tonus is reduced a patient becomes more susceptible to

the effects of unphysiologic positions. With perceptive powers no longer intact he is unable to complain of postural insults which normally he would not tolerate.

Under these conditions, trauma to the nerves or vascular structures may occur and the damage not be discovered until the patient has responded from the anesthetic. Unless the injury is pronounced the impairment of function may not even then be noted without careful postoperative observation. Minor dysfunctions are often masked by heavy postoperative sedation.

The brachial plexus is quite vulnerable to damage from malposition. Clausen has written a detailed account of the anatomical relations of the plexus and its surrounding structures. He evaluates the effect of various positions on the nerve trunks. Injury to the plexus is ascribed to any of several factors which increase the tension in the nerves by increasing the distance between their points of fixation. These factors are: (1) stretching of the nerves over the arch formed by the tendinous attachment of the pectoralis minor to the coracoid process; (2) depression of the clavicle into the retroclavicular space; (3) lateral deviation and extension of the patient's head; (4) stretching of the plexus over the prominence formed by the head of the humerus with the arm in external rotation, abduction and extension; and (5) compression between the clavicle and the first rib. Congenital anomalies such as cervical ribs or anomalous derivation of the plexus may make the nerves more vulnerable (2).

The abnormal relations as just described may be produced by hyperextending the arm on a board as is sometimes done for axillary surgery for infusions or to make room for the surgeon's assistant. If a steep Trendelenburg position with inadequate or poorly placed shoulder braces is employed the patient may be suspended by his wrists thereby stretching

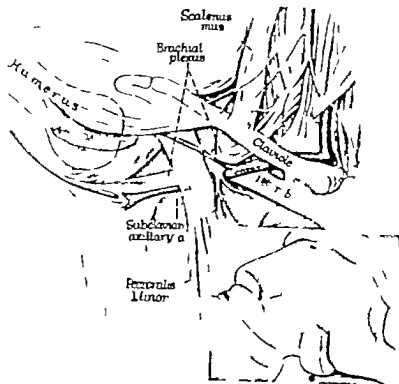


Fig. 1. Anatomical relations of the brachial plexus. Inset, Trendelenburg position showing misplacement of the right shoulder brace as the result of the extension of the arm on an arm board.

the plexus down over the first rib. Injury may also occur from the shoulder brace itself when it is not placed over the bony acromioclavicular joint and is allowed to press on the soft structures in the supraclavicular space. Brachial plexus paralyses have been observed more frequently since the advent of curare. With this additional loss of muscle tonus, misplaced shoulder braces are more likely to compress the nerve trunks of the plexus.

Damage to the brachial plexus may be evidenced in motor and sensory impairment of the arm and shoulder girdle. Instances of Horner's syndrome resulting from injury to the lower roots of the plexus have also been reported (2, 6).

Figure 1 inset shows a patient in steep Trendelenburg position. The right arm has been extended on an arm board for an infusion without the shoulder brace on that side being removed. When the arm is extended from the side to this position while the patient is resting primarily on the shoulder braces the arm acts as a lever and moves the patient to that

side of the table. When this is done the brace no longer presses against the bony acromioclavicular portion of the shoulder but rests against the trapezius muscle and the brachial plexus. Figure 1 gives a diagrammatic conception of the relation of the brachial plexus to its surrounding structures. The weight of the body of the patient resting upon the brachial nerves by pressure or stretching may result in malfunction of the arm on that side. Paralyses occurred in one such instance following a hysterectomy and was noted on the evening of the operative day. The condition remained for 3 days and then gradually improved so that normal function had apparently returned by the ninth postoperative day. In a similar case function in the arm was still impaired when the patient left the hospital 6 weeks later. Wood describes a case with bilateral brachial palsy lasting for 1 year after the operation (12).

The radial, ulnar and median nerves are vulnerable to trauma as they traverse the brachium (Fig. 2). In this illustration it can

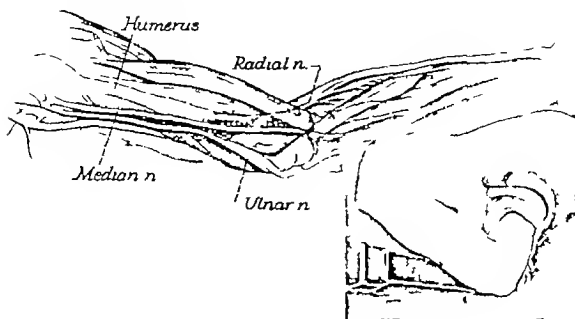


Fig. 2 Schematic presentation of nerves subject to injury. Inset, Improper position of patient on operating table causing pressure against the inner aspect of arm.

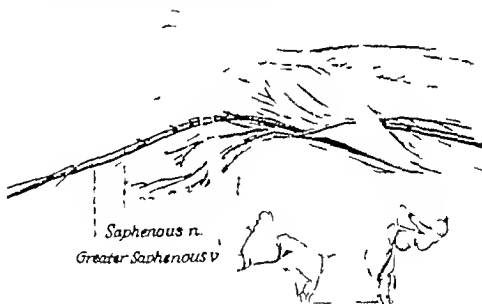


Fig. 3 Diagram of structures vulnerable to pressure from leg braces. Inset, Lithotomy position showing braces pressing against the leg.

be seen that if the arm hangs over the edge of the operating table as in Figure 2, inset the nerve is likely to be compressed between the humerus and the edge of the table. If the surgical assistant leans against the arm, the pressure is augmented and damage to the nerve is likely to occur. Instances of ulnar paralysis have occurred in emaciated patients due to pressure of the arm on the bed (11).

During the course of a pelvic operation with the patient in a moderate Trendelenburg position the right arm was extended on a board for infusion. During the operation this arm was pushed into hyperabduction to make room for an assistant. In doing so the posterior aspect of the arm was forced against the anesthetic screen which was fastened to the edge of the table. Since the arm was beneath

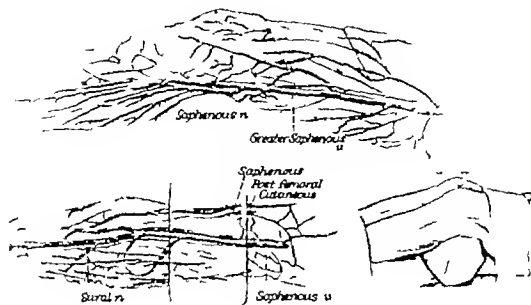


Fig. 4. Diagram of structures subject to injury in the pressure areas illustrated in inset. Inset shows compression of leg between hard knee roll and tight strap.

the drapes this pressure was not noticed until the end of the operation. After operation the patient noticed a weakness of the right arm. Examination revealed a wrist drop and sensory changes indicative of a radial nerve paralysis. This dysfunction persisted 1 month after the operation.

Foot-drop from paralysis of the common peroneal nerve and paresthesia due to damage of the saphenous nerve may be attributed to the lithotomy position. When the metal braces which hold the stirrups are extended (Figure 3 and 3 inset) undue pressure may be placed on the saphenous nerve.

In 1 instance 6 hours following a transurethral resection the patient complained of a numb feeling on the inner side of his right leg. It had been noted at the end of the operation that the metal brace for the stirrup had left a pressure mark on the inner surface of the leg. The nerve function returned in a few days.

The leg braces on obstetrical tables are usually constructed in the form of a curved metal support and the leg rests over this with pressure in the popliteal fossa. Unless these metal leg rests are sufficiently padded there is danger of injury to the common peroneal

nerve as well as to the vascular structures in the popliteal fossa. Tourniquets applied with too much pressure for too long a period (5) or hard knee rolls as are sometimes used in positioning patients on the operating table (Figure 4 and 4 inset) may produce similar injuries.

Coincident with the nerve injuries described there may be peripheral vascular damage.

When the patient's arm is hyperabducted as is described in injuries to the brachial plexus, the subclavian or axillary arteries may be compressed and occluded. Wright in reporting a study of 150 young adults revealed that a pulse of the arm can be obliterated in the position of hyperabduction in approximately 83 per cent of all normal persons. The patients described in his series developed their syndromes for the most part as a result of sleeping with the arms in a hyperabducted position. In one instance this progressed to the point of gangrene of the fingers.

Another vascular complication is venous thrombosis resulting from stasis when braces, padding or straps occlude the superficial veins (Fig. 4 and inset). One patient developed a venous thrombosis of the superficial veins of the thigh because the strap which held the patient in position was secured too tightly.

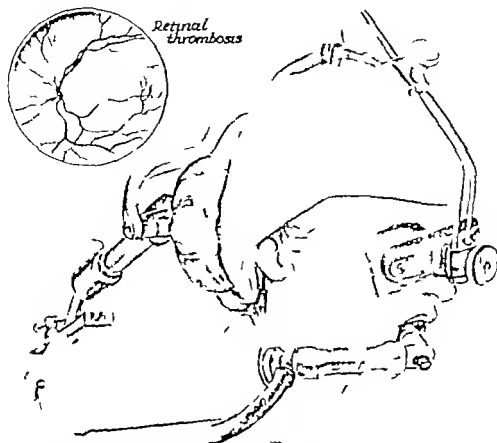


Fig. 5 Pressure on the right eye resulting from the improper position of the head rest. Inset, Retinal thrombosis resulting from pressure on the eye.

An instance of vascular damage of particular significance because of its complications occurred during a neurosurgical procedure for section of the fifth cranial nerve. A Bailey head rest (Fig. 5) was employed. During the procedure the head was pushed to one side and the forehead piece slipped causing pressure on the right eye. This extraocular tension plus the lowered blood pressure due to the effects of gravity and blood loss were undoubtedly responsible for the retinal thrombus (Fig. 5 inset) which was discovered on postoperative examination. During the first day after the operation the patient could not distinguish light from dark. On the second postoperative day she could see objects and detect color. There was no further improvement. The gravity of this picture may be enhanced when it is mentioned that the patient had sight in only this eye prior to the operation.

The foregoing instances which have been cited are not unique. The literature contains numerous examples but in relation to the

number of anesthetics given each year, the incidence of occurrence is small. The fact that these injuries are preventable makes even a few regrettable.

The treatment of nerve injuries of this type is principally physiotherapy. The majority recover completely although in some a permanent residual dysfunction remains. The vascular injuries may respond to physiotherapy. In many instances sympathetic blocks are valuable. Again complete recovery cannot be assured.

Prevention of injuries requires an awareness of the potential dangers of the various positions. There is no substitute for good judgment in considering the requirements of each individual case. In those positions where strain or pressure on the neurovascular system of the patient is obvious or probable the position should be altered until both anesthesiologist and surgeon are satisfied that the patient is adequately protected.

Points of obvious pressure should be properly padded, and when straps are used to

hold the patient in position they should be examined to see that they are not too tight.

Both the anesthetist and the surgeon should be constantly alert to the effects of malposition.

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VARIOUS TYPES OF DIAPHRAGMATIC HERNIA TREATED SURGICALLY

Report of 430 Cases

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DIAPHRAGMATIC hernia is an inclusive term and is commonly used to designate any condition in which the abdominal contents protrude into the thoracic cavity through an abnormal opening in the diaphragm. These abnormal openings may be attributable to congenital structural deficiencies of the diaphragm or they may be caused by traumatic rupture or inflammatory necrosis of the normal diaphragm. All true hernias have a sac as one of their component parts so that many conditions commonly included under this term but which do not have hernial sacs would more properly be termed eviscerations or 'false hernias'. The occurrence of herniation of abdominal viscera through the diaphragm is relatively uncommon when compared with the frequency of herniations through the abdominal wall but more different kinds of hernia occur through the diaphragm than through the other walls which encase the abdominal contents. The reason for the different types of diaphragmatic hernias is the unusual embryologic formation of the diaphragm which makes for weak parts through which these hernias may occur.

The formation of the diaphragm from embryonic structures is a highly complex process because the muscular elements of the diaphragm are derived from several sources. The anterior lateral and central parts which comprise the greater portion of the diaphragm in the adult person are formed from the transverse septum and fused ventral mesentery. The remaining posterolateral portion is formed by the fusion of the dorsal mesentery and the mesoderm derived from the receding wolffian body with the pleuroperitoneal membrane derived from the pulmonary ridge. It is difficult to determine the exact amount of

muscle tissue that is derived from each of these structures since considerable variation probably occurs during the process but it is likely that the dorsal mesentery forms the posterior and central portions which contain the esophageal opening. The mesodermal cells form the receding wolffian body from the right and left crura. The pleuroperitoneal membrane grows ventrally and by fusion with the transverse septum closes the remaining opening which may be designated as the pleuroperitoneal hiatus between the peritoneal celom and the pleural celom. This completes the formation of the posterolateral portion of the diaphragm (Fig. 1).

Failure of fusion or failure of proper deposition of the mesoderm at any one of these adjacent points of union may result in congenital continuity of the pleural and peritoneal cavities or a congenitally weak portion in the diaphragm at any of these points. Consequently, from an embryologic standpoint weak portions might be expected to appear at the points of fusion of these different structures. These portions are situated dorsolaterally at the fissura pleuroperitonealis which when covered with peritoneal and pleural membranes is termed the foramen of Bochdalek and also through the outer crus of the diaphragm and through the esophageal opening. The dome of the diaphragm embryologically is not a fused region. Herniation through the dome therefore cannot be explained on the basis of weak points of fusion. Such a hernia may be the result of excessive degeneration of the muscle in the formation of the central tendon or of some pathologic condition. Unilateral absence of the diaphragm probably is the result of the failure of development of the pleuroperitoneal membrane which usually is found as a narrow ridge of tissue along the posterior wall of the thorax.

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CLASSIFICATION OF DIAPHRAGMATIC HERNIA

There are numerous classifications of diaphragmatic hernia which are based on the embryologic and etiologic aspects, pathologic anatomy, the site of the opening in the diaphragm, the presence or absence of a sac, the contents of the hernia and other factors. It is difficult or impossible to make use of most of these classifications after clinical examination accordingly many of them are of little clinical value. The most accurate determination of the various types of diaphragmatic hernia is that obtained at the time of operation.

From a clinical and surgical standpoint the history of an injury is helpful in establishment of the diagnosis and in determination of the type, urgency and prognosis of the operative treatment. Because of the practical clinical and surgical significance of trauma as an etiologic factor I have suggested that diaphragmatic hernia be classified into two main groups, nontraumatic and traumatic. I have subdivided these two groups according to the various types.

Nontraumatic hernia. A nontraumatic diaphragmatic hernia may be congenital or acquired. If it is congenital the hernia is attributable to embryologic deficiency and usually does not have a hernial sac. The common sites of a congenital hernia, in the probable order of frequency of occurrence are (1) through the pleuroperitoneal hiatus, (2) through the gap left by partial absence of the diaphragm, a gap which is usually situated in the posterior portion of the muscle, (3) through the esophageal hiatus due to a deficiency of the circular muscle bundles of the hiatus, (4) through the esophageal hiatus due to deficiency of the esophagus which is not elongated sufficiently to extend to the diaphragm, thus causing varying amounts of stomach to remain above the diaphragm depending on the amount of shortening of the esophagus, and (5) through an anterior subcostosternal opening (foramen of Morgagni or Larrey's spaces).

I have used the term 'pleuroperitoneal hiatus' to designate a congenital complete opening between the pleural and peritoneal cavities due to a lack of complete fusion of the septum transversum and the pleuroperitoneal membrane. Hernias occurring through this open-

ing do not have a hernial sac. When there is incomplete muscular formation of the diaphragm in this region of fusion of the pleuroperitoneal membrane and septum transversum but complete covering of the space with pleural and peritoneal membranes which complete the separation of the abdominal from the pleural cavities, this space of muscular deficiency of the diaphragm is called the foramen of Bochdalek. Hernias occurring through this partially defective region of the completed diaphragm would have a hernial sac of peritoneum and pleura. I have not encountered a diaphragmatic hernia in this region which had a hernial sac.

If the hernia is acquired after birth the sites of occurrence are (1) through the esophageal hiatus, a type in which there is a hernial sac, (2) through the region of fusion of the Anlage of the diaphragm, and (3) at sites named under the congenital types of hernia.

Traumatic hernia. Traumatic diaphragmatic hernia may be caused by direct or indirect injury or by inflammatory necrosis of the diaphragm. In cases of indirect injury of the diaphragm the hernia may occur at any point including points of embryologic fusion but the most common sites are the dome and the posterior half of the left part of the diaphragm. On the other hand the hernia may occur in the right part of the diaphragm. It usually is the result of a severe, crushing injury. When the hernia occurs through the esophageal opening there is a sac but when it occurs through the leaf of the diaphragm there usually is no sac. In case of direct injury of the diaphragm hernia may occur at any point and is usually the result of penetrating wounds, such as those inflicted by a gun or knife.

Rupture of the diaphragm may be the result of inflammatory necrosis, which in turn, has been caused by subdiaphragmatic abscess. Again rupture may follow necrosis caused by drainage tubes which have been introduced into pyemic cavities. In these cases the opening usually is situated in the posterior part of the diaphragm and there is no hernial sac.

CLINICAL AND SURGICAL CONSIDERATIONS

In my experience the most common types of diaphragmatic hernia which require surgical

TABLE L.—DATA IN 430 CASES OF DIAPHRAGMATIC HERNIA IN WHICH OPERATION WAS PERFORMED

Site of opening	Cases	Cause	Contents of hernia	Cases
Esophageal hiatus	304	Congenital defect (history of trauma, 7)	Stomach (occasional) Stomach, omentum and spleen Stomach and colon Stomach only	204 6 7 13
Short esophagus type	15	Congenital defect ()	Right colon and small bowel Colon, small bowel, stomach and spleen Colon, small bowel and appendix	
Hiatus, pleuroperitoneal	9	Congenital defect	Stomach, colon, small bowel and spleen Small bowel and colon Small bowel, colon, spleen, appendix () and stomach ()	5 5
Absence posterior fourth left diaphragm		Congenital defect	Colon and omentum Stomach and colon	7
Foramen of Morgagni (subcostal)	8	Congenital defect (right side of diaphragm, 4 lateral,)	Stomach only Stomach and colon Stomach, colon, small bowel (20), spleen () and liver (4)	7 34
Left diaphragm	37	Trauma (direct injury 44; direct 1 jury, 7) subdiaphragmatic necrosis, 6)	Stomach, colon, small bowel, liver, gall bladder and head of pancreas	430
Right diaphragm		Trauma (direct)		
Total	430			

caused by laceration of a normal diaphragm. However they also may be of congenital origin and may result from congenital structural deficiency of the diaphragm. The symptoms in these cases are more varied and severe than those in the first group because of the multiple structures involved and are often more acute in onset. The initial symptoms may be those of acute intestinal or gastric obstruction or severe hemorrhage.

From the standpoint of treatment diaphragmatic hernia is primarily a mechanical condition and the only treatment which will relieve the condition is operative repair or reconstruction of the abnormal opening in the diaphragm after replacement of the herniated viscera into the abdomen. The indications for surgical intervention and methods and technique of surgical procedures depend on the type, situation and size of the defect in the structure of the diaphragmatic muscle, the kind, number and amount of abdominal viscera involved in the hernia and whether or not the viscera are enclosed in the hernial sac.

In the treatment of all hernias that have occurred through the left portion of the diaphragm I prefer the abdominal approach by means of an oblique left rectus incision starting at the ensiform cartilage and extending to the outer border of the rectus muscle. I believe there is less risk of the occurrence of thor-

acic complications when this approach is used. It is of particular advantage in cases of esophageal hernia for the herniated stomach is usually confined in a sac in the posterior part of the mediastinum and does not enter the true pleural cavity.

In the repair of hernias through the right portion of the diaphragm I prefer the thoracic approach because the large right lobe of the liver makes the abnormal opening in the diaphragm inaccessible from the abdominal approach.

The technical difficulties of adequate exposure of the hernial openings through the left portion of the diaphragm and the esophageal hiatus are often considerable because of fixation of the left lobe of the liver to the leaf of the diaphragm. The exposure of these hernial openings is greatly facilitated by cutting the suspensory ligament and retracting the left lobe of the liver to the right. This can be accomplished when the left lobe is small by folding it on itself and when it is large by retracting it forward into the wound. The spleen is often adherent to the posterior part of the diaphragm and to the margins of hernial openings but usually can be separated from these structures by blunt dissection. In some instances the spleen has been so traumatized by the injury and so bound into an abnormal position by adhesions, that it cannot be sep-

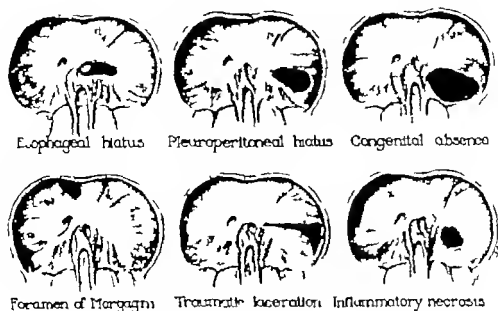


Fig. 2. Situations of congenital structural defects and traumatic lacerations of the diaphragm which cause the more common types of diaphragmatic hernia. (Courtesy *Western Journal of Surgery*.)

erated from the structures at the site of the hernial opening without seriously injuring it. This is likely to occur in the traumatic types of hernia and occasionally in esophageal hiatus hernia. In these cases splenectomy is necessary.

Paralysis of the diaphragm produced by temporary or permanent interruption of the phrenic nerve is of value as a procedure preliminary to radical operative repair of esophageal hiatus hernias. It is a necessary procedure in the surgical treatment of partial thoracic stomach resulting from a congenitally short esophagus. In some cases in which radical operative repair is contraindicated interruption of the phrenic nerve may be used as a palliative measure.

ESOPHAGEAL HIATUS HERNIA

Herniation of the abdominal viscera through the esophageal hiatus may be present at birth or may occur at any time during life. The occurrence at birth of this type of hernia is relatively uncommon as compared with other types of diaphragmatic hernia of essentially congenital origin but esophageal hiatus hernia is the most common type of diaphragmatic hernia which is encountered in adult life. These hernias are of considerable general interest because of the relative frequency of

their occurrence, their indefinite causation, the variation of the relationship between the defective esophageal hiatus and the structures involved in the hernia, the progressive character of their development, the varied and complex symptoms produced by them and because of their treatment which may be conservative if the hernias are small and symptoms mild but which may embrace surgical treatment if the hernias are large.

The symptoms of esophageal hiatus hernia may begin at birth or at any time during later life. Because of the progressive character of this type of hernia, the symptoms vary as the hernia becomes larger depending on the degree and type of herniation present. Therefore because of changing symptoms several different clinical diagnoses can be made in the same case depending on the time at which the patient is examined. Accordingly the condition may be termed the *masquerader* of the upper part of the abdomen. This I believe is the most important clinical consideration of diaphragmatic hernias through the esophageal hiatus. In a study of 343 cases of this type of hernia in which I have performed operations (Table I) it was found that an average of three previous erroneous clinical diagnoses had been made in these cases before the correct diagnosis was established. The common erroneous

diagnoses in order of frequency were found to be cholecystitis, cholelithiasis, gastric ulcer, duodenal ulcer, hyperacidity, secondary anemia, cardiac disease, carcinoma of the cardia, stricture of the esophagus, appendicitis, and intestinal obstruction. In 34 of the 343 cases the patients had been operated on previously for other conditions without complete relief of symptoms. They were completely relieved of symptoms after repair of the hernia.

The chief symptoms of esophageal hiatus hernia are pain, distress, gaseous eructation, vomiting, dyspnea, hemorrhage, weakness, anemia, and palpitation of the heart. At the onset the symptoms are usually mild; they consist of epigastric distress that is projected through to the back and which comes on in the course of or shortly after a heavy meal. However, at times the distress may be brought on by taking anything into an empty stomach, even a cupful of coffee. The attacks of distress are usually similar to one another in character but vary in intensity depending on the amount of stomach that becomes incorporated in the hernia and the degree of interference with the diaphragm as well as the size of the hernial orifice and the associated complications, such as traumatic ulcer and incarceration of the stomach.

As the amount of the stomach incorporated in the hernia increases, the attacks become more severe. The pain is projected straight through to the back and to the lower left side of the thorax, is more marked to the left of the spinal column than elsewhere in the back and often appears between the scapulae. This pain may be agonizing and difficulty is experienced in belching of gas and vomiting because of spasm of the diaphragm and reflex cardio-spasm. The spasm of the diaphragm produces an hourglass deformity of the stomach which interferes with emptying of the upper loculus and causes increased intragastric pressure. The pressure of the herniated portion of the stomach on the lower part of the esophagus also interferes with the belching of gas or vomiting. Spasm of the diaphragm commonly is associated with phrenic pain which is referred to the left shoulder and at times may be projected down the arm. The increased pressure within the thorax causes cardiac embar-

assment with palpitation and tachycardia. The pressure on the lung and the interference with the motion of the diaphragm cause dyspnea. These symptoms are augmented when the patient lies down and in the more severe instances of the condition it is necessary for patients to sit up to breathe. The attacks may last for a few minutes to several hours and occasionally they are considered to be caused by coronary sclerosis or by myocardial disease. The attacks usually are relieved by vomiting and often recur immediately after food is taken.

The intervals between attacks often last for weeks or months. It is probable that during the interval between attacks the stomach is not incorporated in the hernial ring but is situated in its normal position below the diaphragm. When the attacks become more or less constant, the constancy usually indicates that the stomach has become fixed in the thorax by adhesions. All the early symptoms of pressure are augmented during the attacks. Weight is lost because of the patient's inability to retain food and because of the marked restriction in diet. The latter is the result of the patient's fear of bringing on an acute attack. The vomiting is more severe than in early attacks and often is of the retention type. During the severe vomiting the vomitus may contain blood. If the attacks are of long standing the patient not uncommonly has a burning sensation in the epigastrium after meals, which is relieved by taking small quantities of food. If a large amount of food is taken it may bring on one of the attacks that is associated with incarceration of the stomach. Many of these patients present a comparatively typical syndrome of peptic ulcer; are given medical care and obtain partial relief because they take a restricted amount of food at frequent intervals.

Hemorrhage is not an uncommon sign. It is due to a traumatic ulcer which is usually situated in the lower end of the esophagus close to its juncture with the stomach; it may be found near the lesser curvature in that portion of the stomach which is in the hernial sac. These traumatic ulcers result from the to-and-fro action of the stomach in the hernial ring when the hernia is small as well as from the

forceful pressure exerted on the large distorted and congested stomach during the attacks of vomiting when the hernia is large. There is also the additional factor of regurgitation of gastric juices into the lower part of the esophagus which produces esophagitis.

The bleeding from the traumatic erosions may be severe and hematemesis or melena is often one of the chief signs. This type of hemorrhage is more common in cases in which repeated severe attacks of obstruction occur from incarceration of the stomach in the hernial sac than in other cases. In some instances the hemorrhage that results from the ulceration is severe enough to endanger life. Traumatic ulcers which may be multiple are usually relatively superficial and their presence depends on the mechanical derangement of the herniated stomach. After repair of the hernia and replacement of the stomach into its normal position most of these traumatic ulcerations heal spontaneously. In several cases the traumatic ulcer has become more deeply seated, has simulated the usual type of peptic ulcer and has not healed after repair of the hernia. In the few cases of this type that I have seen the symptoms have been of long standing or severe incarceration of the stomach has occurred.

In other instances the patient may not be aware of any bleeding and may have severe secondary anemia resulting from occult hemorrhage into the stool. I should like to emphasize that secondary anemia is one of the important clinical manifestations of this type of hernia.

In cases in which surgical treatment of the hernia is considered one of the most important groups is that in which the symptoms simulate angina pectoris. Often however there are no definite findings on which the diagnosis of coronary disease can be established. It is to be remembered that although a patient has a definite esophageal hiatus hernia that could explain the symptoms, he also can have coronary sclerosis without proved signs and if this latter condition is present, it constitutes a marked hazard to surgical intervention for the hernia.

From the standpoint of general management, cases of esophageal hiatus hernia may

be divided into three groups. In the first group the hernias are small, are recognized roentgenologically often during the course of a general examination and produce few or no symptoms. No treatment is indicated in this group of cases. The second group includes those cases in which the symptoms are only moderately severe and the hernias are of moderate size. In many of the cases in this group conservative treatment such as regulation of diet and reduction of weight is sufficient to relieve the symptoms. The third group includes those cases in which there is no response to conservative measures, the hernias usually are large and in many cases in my experience there are complications, such as incarceration of the stomach or gastric erosion. In this group of cases the only treatment that assures relief of symptoms is operative repair of the hernia.

In all cases in which a third or more of the stomach is involved in the hernia, surgical intervention should be considered because the condition will progress and usually the rate at which the enlargement increases becomes more rapid after the hernia has attained this size. Operation should be performed before severe incarceration with consequent obstruction and traumatic lesions of the stomach has occurred. The operative risk is increased by gastric retention and the technical difficulties are enhanced by fixation of the stomach to the diaphragm and to the hernial sac within the thorax. In all cases in which the colon is involved in the hernia, early operation is necessary because of the danger of occurrence of intestinal obstruction.

While all hernias through the esophageal hiatus are considered under the general term 'esophageal hiatus hernia,' three different types are important from the standpoint of surgical technique. In the first type the esophagus has maintained its attachment to the diaphragm and the cardinal end of the stomach has herniated through the abnormal opening along the side of the esophagus. This is commonly called a para-esophageal hiatus hernia. It is however relatively infrequent and does not constitute more than 20 to 25 per cent of cases in which the patient comes to surgical treatment. In the second type the esophagus is markedly retracted or shortened into the

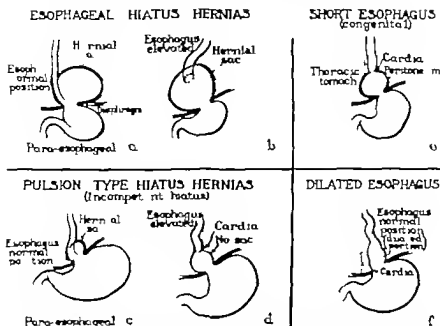


Fig. 3. Diagrammatic drawings of different types of esophageal hiatus hernia and some of the conditions which may simulate hiatus hernia roentgenologically. a, Para-esophageal hiatus hernia with herniation of the cardiac end of the stomach through the esophageal hiatus. The esophagus is in normal position. b, Esophageal hiatus hernia in which the greater portion of the stomach is herniated through an enlarged esophageal hiatus to the posterior mediastinum. The esophagus is elevated. c, Slight protrusion of the cardia of the stomach through the hiatus with slight elevation of the lower part of the esophagus to the upper margin of the esophageal hiatus. PulSION type of the hernia with incompetent hiatus. d, Protrusion of cardiac end of the stomach through the esophageal hiatus and marked elevation of the esophagus into the posterior mediastinum. Incompetent hiatus. e, Congenital short esophagus with partial thoracic stomach. f, true hernia. g, Dilatation of the lower end of the esophagus, cardiac antrum. Not hiatus hernia. (Courtesy *American Journal of Surgery* 3)

mediastinum but is long enough to reach the diaphragm when traction is exerted. From 75 to 80 per cent of cases in which treatment is surgical are of this type. The hernias are usually larger than those of the first type and the results are not as favorable from a surgical standpoint, for recurrences are more likely to develop because of the difficulty of re-establishing fixation of the lower part of the esophagus to the diaphragm. The third type of hernia is that of the true short esophagus with partial thoracic stomach and may also include cases of cicatricial contraction with fixation of the esophagus. This type of hernia presents an entirely different surgical problem from the true esophageal hiatus hernia (Fig. 3).

Interruption of the phrenic nerve. Temporary interruption of the left phrenic nerve is an advisable procedure preliminary to abdominal

repair of most esophageal hiatus hernias. This is particularly true in adults. In infants it is usually not necessary. Temporary interruption of the phrenic nerve is accomplished by crushing the nerve with forceps. Following this procedure the function of the diaphragm is impaired for from 3 to 6 months and at the end of that time normal or nearly normal function will be re-established. In this type of hernia permanent paralysis of the diaphragm is rarely necessary. In fact I prefer not to have the paralysis of the diaphragm complete even after the crushing of the nerve because a slight amount of motion will prevent atrophy of the muscles of the diaphragm. In cases in which re-establishment of function of the diaphragm is not desired because of the danger of recurrence of the hernia paralysis can be made permanent by cutting or evulsing the phrenic

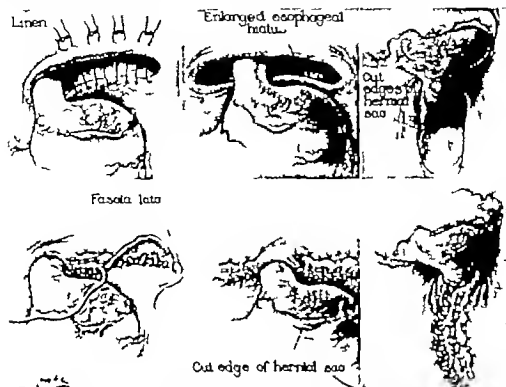


Fig. 4. The more common types of structurally deficient esophageal openings which permit herniation of the stomach into the posterior mediastinum and the method of repair of each type of opening with fascia lata and linen after removal of the hernial sac. (Courtesy *Western Journal of Surgery* 5)

nerve. As a procedure preliminary to radical surgical treatment, interruption of the phrenic nerve is often of value in treatment of incarcerated and strangulated hernias because it prevents spasm of muscle and causes relaxation of the hernial ring.

Permanent interruption of the phrenic nerve may be a necessary procedure in the surgical treatment in a case in which part of the stomach lies in the thorax due to a congenitally short esophagus. However I wish to emphasize that permanent interruption of the phrenic nerve is rarely necessary and should never be done in cases of esophageal hiatus hernia until it is definitely ascertained that it is not advisable to re-establish the function of the diaphragm. It should be emphasized also that this procedure cannot replace the operative repair of the hernia. It is important to bear in mind that the atrophy of the diaphragmatic muscle which follows permanent interruption of the phrenic nerve may make it impossible to obtain a satisfactory result in the event that further repair of the hernia is necessary.

Radical surgical repair. I prefer the abdominal approach in all cases of esophageal hiatus

hernia because the herniated viscera are contained in a sac in the posterior mediastinum and do not enter the true pleural cavity. As stated before an oblique incision is made in the left rectus muscle and peritoneum from the ensiform cartilage to the outer border of the muscle. The technical difficulties of adequate exposure of the esophageal hiatus are often considerable because of fixation of the left lobe of the liver to the leaf of the diaphragm. The exposure of the hiatus is greatly facilitated by cutting the suspensory ligament and retracting the left lobe of the liver to the right. This can be accomplished when the left lobe is small by folding it on itself and when it is large by retracting it forward into the incision. The spleen is often very adherent to the posterior part of the diaphragm near the site of the hernial opening but usually it can be separated from these structures by blunt dissection. It is retracted posteriorly by a specially constructed retractor. In some instances the spleen may be almost drawn into the hiatus and may be so traumatized by separating it from its peritoneal attachments that its removal is advisable.

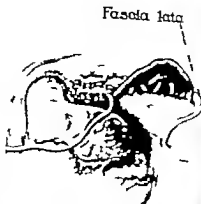


Fig. 5. Patient, red 49 years. Herniation of the caudal end of the stomach through the esophageal hiatus and some displacement of the lower part of the esophagus (condition previously diagnosed as disease of the gall bladder). a Same patient as in b. Enlarged esophageal hiatus repaired to the left of the esophagus with interrupted silk sutures and continuous sutures of fascia lata by lapping the

anterior margin over the posterior margin of the opening. c, Roentgenogram showing same patient as presented in a and b, 3 weeks after repair of the hernia. The entire stomach is now below the diaphragm which is elevated because of the temporary interruption of the phrenic nerve. The esophagus is in normal position. (Courtesy of the *Annals of Surgery* 4.)

Hernias through the esophageal hiatus are true hernias each has an hernial sac consisting of abdominal peritoneum which is continuous with the serosa of the stomach. The attachment of the sac to the stomach must be separated and the sac must be either completely removed or permitted to retract into the posterior portion of the mediastinum. I believe that this is one of the most important technical considerations in the surgical treatment of this type of hernia.

After the sac has been removed the enlarged defective esophageal hiatus is repaired by overlapping the margins of the opening (Fig. 4). In many instances it is necessary to elevate the repaired hiatus to a higher position on the esophagus. This is an important procedure in those cases in which the esophagus is short or is elevated into the thoracic cavity (Fig. 5). The hiatus is usually repaired to the left of the esophagus but in some cases it is necessary partially to repair it both to the right and to the left of the esophagus (Fig. 6). In some instances the defect of the esophageal hiatus is posterior and it extends to the spinal column. In repair of this type of opening the margins posterior to the esophagus must be overlapped. This condition is often thought to be a herniation through the aortic opening

but over the aorta there usually is an imperfectly developed fibrous band which is the margin of the defective esophageal hiatus (Fig. 7). The closure is usually made with living sutures of fascia lata, which are removed from the thigh. The overlapped margins of the hernial opening are first stabilized with interrupted linen sutures. The fascia lata is then woven into the tissues by continuous suture and fixed in the tissues with interrupted linen sutures.

In many instances in which the stomach is incarcerated or obstructed it is impossible to pass a stomach tube into the obstructed loculus of the stomach before operation. In these cases it is advisable soon after the abdomen is opened, to pass a stomach tube and to direct it into the obstructed portion of the stomach in order to empty the gastric contents before any attempt is made to reduce the herniated viscera, because of the danger of regurgitation and aspiration of gastric contents into the lungs. Before closure of the defective esophageal hiatus is completed around the lower part of the esophagus, it is important that a stomach tube of large caliber be passed through the esophagus into the stomach to aid in the reconstruction of the esophageal opening and to prevent constriction of the

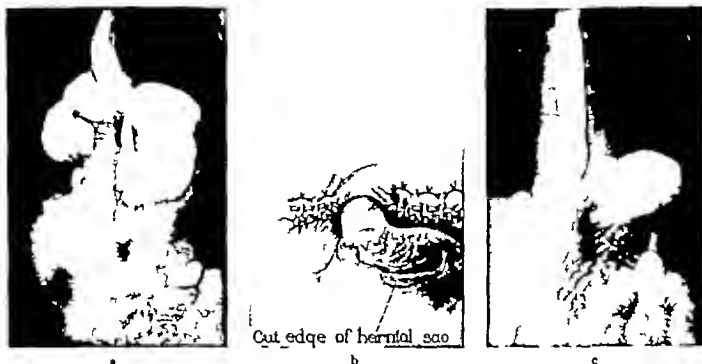


Fig. 6 a. Patient aged 55 years. Esophageal hiatus hernia with herniation of the entire stomach, which is inverted and of a portion of the duodenum with marked elevation of the esophagus and also herniation of the transverse colon through the esophageal hiatus. b Same patient as in a Repair of the markedly enlarged esophageal hiatus by overlapping the anterior margin over the posterior margin on both sides of the esophagus and at a higher level on the

esophagus. Interrupted silk sutures and continuous sutures of (sacra lata were used in the repair. c. Same patient as in a and b 3 weeks after repair of the hernia. This roent genogram shows the entire stomach in normal position below the diaphragm which is slightly elevated as a result of interruption of the phrenic nerve. The esophagus is in normal position and extends to the diaphragm (Courtesy *Annals of Surgery* 4.)

esophagus by a tight closure. The loose areolar tissue or a small portion of the esophageal wall at the cardia is incorporated in the innermost margin of the closure by a suture of chromic catgut.

The abdomen always should be thoroughly explored for the presence of any other lesion particularly of the stomach or gall bladder. In some cases it may be necessary to operate on other associated lesions. However I do not believe it advisable to carry out any additional surgical procedure at the time the hernia is repaired unless it is imperative. It is well to know however whether the patient has gall stones or any other lesion in the upper part of the abdomen which might account for subsequent symptoms.

Inasmuch as the surgical treatment of this type of hernia is a repair of an abnormally large hiatus of the esophagus and not a complete closure of an abnormal opening it is associated with a higher percentage of recurrence than any other type of diaphragmatic hernia. In fact 9 out of 10 recurrences in the entire

series of 430 cases were of this type of hernia. Symptoms of 4 of the 9 patients who had recurrences were severe enough to require a second operation. There were 7 deaths (2.0 per cent) in the 343 cases of diaphragmatic hernia through the esophageal hiatus.

Surgical repair of hernias with congenitally short esophagus. The surgical treatment of congenitally short esophagus with partial thoracic stomach presents an entirely different technical problem from that of other types of esophageal hiatus hernia. The essential consideration in the surgical treatment of esophageal hiatus hernia is that of replacement of the herniated stomach into the abdomen, the removal or obliteration of the hernial sac and the repair and reconstruction of the esophageal hiatus accurately around the lower part of the esophagus.

Congenitally short esophagus with partial thoracic stomach is not a true hernia through the diaphragm in that the stomach has never been in its normal position below the diaphragm because of the short esophagus. The

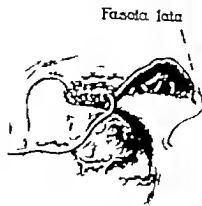


Fig. 5. Patient, aged 49 years. Herniation of the caudal end of the stomach through the esophageal hiatus and some displacement of the lower part of the esophagus (condition previously diagnosed as disease of the gall bladder). Same patient as in Fig. 1. Large esophageal hiatus repaired: the left of the esophagus with interrupted silk sutures and continuous sutures of fascia lata by laying the

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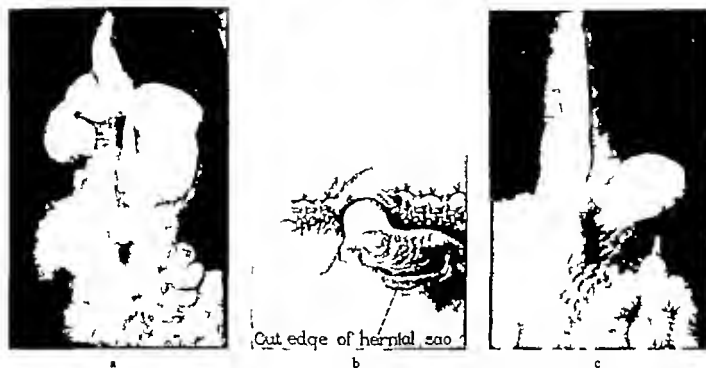


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Fig 7 Patient aged 7 years. a, Esophageal hiatus hernia with herniation of the pyloric to thirds of the stomach into the right thoracic cavity. Stomach is enormously dilated due to incarceration and obstruction (condition previously diagnosed ulcer with obstruction). b Same patient as in a. The enlarged hiatus, defect posteriorly has been repaired with interrupted silk sutures and

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surgical problem in these cases is that of reconstructing the diaphragm over the elevated portion of the stomach this can be accomplished if the esophagus is not too short. By complete and permanent interruption of the phrenic nerve the diaphragm usually can be elevated from 2 to 5 centimeters and then by complete separation of the attachment of the esophageal hiatus, from 2 to 3 centimeters of the esophagus can be drawn down into the abdomen. The elevation of the diaphragm and the pulling down of as much as possible of the esophagus into the abdomen permit the esophageal hiatus to be closed around the lower end of the esophagus by this means the thoracic portion of the stomach is placed below the diaphragm

the posterior portion of the diaphragm and those through the foramen of Morgagni (Larrey's spaces)

In the first two types there is rarely if ever an hernial sac and the abdominal viscera are in direct contact with the thoracic viscera. In the third type (subcostosternal) there is always an hernial sac which consists of peritoneum and parietal pleura.

The symptoms of congenital types of diaphragmatic hernia due to structural deficiencies in the formation of the diaphragm in which multiple abdominal viscera are involved and which are rarely confined in an hernial sac are often complex. This complexity is due to mechanical interference with the function of the herniated viscera as well as to marked interference with the function of the heart and lungs. Because of the occurrence of the hernia at birth the respiratory and cardiac symptoms are usually the most severe. They are due to the marked unilateral derangement of intrathoracic pressure at a time when the compensatory respiratory and cardiac reserves have not been developed to a sufficient degree to maintain function of these organs. Many infants born with these congenital defects die

CONGENITAL DIAPHRAGMATIC HERNIAS DUE TO MALFORMATION AND STRUCTURAL DEFICIENCIES OF THE DIAPHRAGM

Congenital diaphragmatic hernias may occur through either the right or the left side of the diaphragm but the latter site is much more common. The common hernias of this type are those through the pleuropentoneal hiatus those due to the lack of formation of

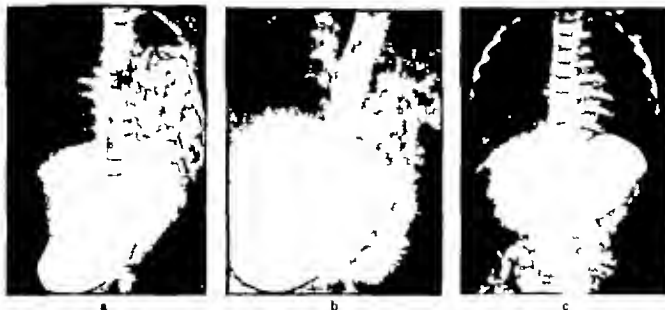


Fig. 8 Patient, aged 4 months. a and b. Pleuroperitoneal hiatus hernia with herniation of many loops of large and small bowel in the left side of the thoracic cavity. Marked displacement of the mediastinum and heart to the right. The stomach is dilated and below the diaphragm

c. Same patient on re-examination 1 year after operation. The stomach and the intestines are entirely below the diaphragm, which is of normal contour and position. The heart and the mediastinum are in normal position. Both pulmonary fields normal. (Courtesy *Annals of Surgery* 4.)

in the first few hours or days of life. However if the respiratory and cardiac mechanisms are able to compensate for the presence of the abdominal viscera in the thorax these patients may live on to childhood or even to adult life without any great amount of disability or symptoms provided that intestinal or gastric obstruction does not develop. Obstruction is less likely to develop in these cases than in the cases of traumatic hernia because there are usually fewer adhesions between the abdominal and the thoracic viscera. When the stomach is involved in these congenital hernias it usually becomes dilated and symptoms of partial gastric obstruction are relatively common. Intestinal obstruction may occur owing to bands of adhesions between the omentum and loops of bowel or owing to inflammatory conditions of the bowel. Inasmuch as there is usually a nonrotation of the right portion of the colon and the cecum and the appendix is in the left side of the thorax appendicitis may develop and produce a serious hazard to life.

In the surgical treatment the approach in the first two types may be either thoracic or abdominal but I prefer the abdominal approach and an oblique left rectus incision. In the third type (subcostosternal) the approach should always be through the abdomen and

usually with an oblique right rectus incision or a transverse incision in the epigastrium. I prefer the oblique right rectus incision.

Pleuroperitoneal hiatus hernia. These hernias occur in the posterolateral portion of the diaphragm and are due to failure of fusion of the pleuroperitoneal membrane and the septum transversum. The defect is usually triangular with the apex toward the median portion of the diaphragm. The defect usually extends to the thoracic wall but occasionally an imperfectly developed band of muscle tissue extends along the thoracic wall. These hernias do not have hernial sacs and there is a direct communication between the abdominal and the thoracic cavity.

The most common abdominal viscera involved in this type of hernia are the colon and the small bowel. There may or may not be herniation of the spleen and stomach. There is often a failure of rotation of the colon and the entire right side of the colon (appendix and cecum) the terminal part of the ileum and all of the small intestines to the jejunum are involved in the hernia (Fig. 8).

This type of hernia is said to be the most common of the congenital types of hernia due to structural deficiencies. These hernias are present at birth. Many of the infants suffering



Fig 7 Patient aged 7 years. a, Esophageal hiatus hernia with herniation of the pyloric two-thirds of the stomach into the right thoracic cavity. Stomach is enormously dilated due to incarceration and obstruction (condition previously diagnosed as liver with obstruction). b Same patient as in a. The enlarged hiatus, defective posteriorly, has been repaired with interrupted silk sutures and

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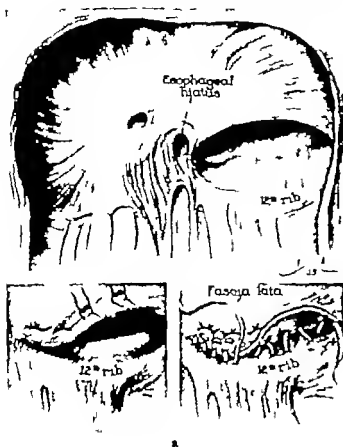


Fig 10 Same case as in Figure 9. a At operation absence of posterior part of left side of diaphragm repair of defect by suturing posterior margin of diaphragm to intercostal muscles with interrupted silk sutures and with fascia lata. b Same case after operation. Stomach is in normal position below the left side of diaphragm, which is in normal relation to right side of diaphragm. Heart and mediastinum are in normal position. Pulmonary fields negative (Courtesy American Journal of Surgery 3.)

pletely closed the air is aspirated from the pleural cavity through a catheter connected to a suction apparatus. At the time of withdrawal of the catheter the last suture is tied and the communication between the thorax and the abdomen is closed.

One of the chief dangers associated with the repair of hernias of this type is the marked alteration of intrathoracic or intra abdominal pressure. It is important that respiratory function be maintained by positive pressure with oxygen during the operation and that at the completion of the operation negative pressure be obtained and secured in the thoracic cavity. A roentgenogram should be taken at the completion of the operation to see that there is no shift of the mediastinum due to the pneumothorax. I do not permit patient to leave the operating table until I have seen the roentgenogram. If any shift occurs, more air is withdrawn to maintain mediastinum in midline.

In my series of 9 cases of hernia through the pleuropentoneal hiatus there were no recurrences and 3 deaths.

Congenital absence of the posterior portion of the diaphragm. This type of hernia is due to

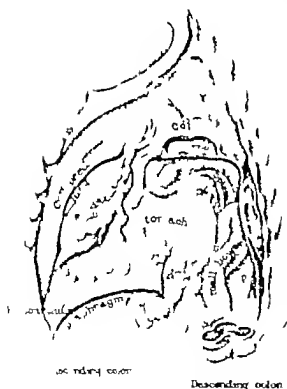
failure of the formation of that portion of the diaphragm which is derived from the pleuropentoneal membrane. The defect is in the posterolateral portion of the diaphragm and usually extends posteriorly from the eighth rib and medially to the esophageal hiatus. Such an hernia usually does not have a sac but there may be an imperfectly developed enveloping membrane of peritoneum and omentum which simulates a sac. These hernias may be considered an enlargement of the foregoing pleuropentoneal type in that the essential difference is a much more extensive congenital defect in the formation of the diaphragm. There are more abdominal viscera involved than in the pleuropentoneal hernia as the stomach and spleen, also the large and small intestine often are included. The left kidney may be elevated above normal level into pleural cavity (Figs. 9 and 10).

The surgical problems associated with hernia of this type are the same as those of pleuropentoneal hernia as far as altered intra abdominal and intrathoracic pressure is concerned but in addition there is the problem of



b

FIG. 9. Patient, aged 3 years. a, Congenital absence of portion of diaphragm. Left side of thoracic cavity almost completely filled with hollow viscera displacing the mediastinum to the right. b, Same case as in a. Entire stomach is in left side of thoracic cavity. Colon is distended with air and seen to the outer side of the stomach and extending above it. c, Same case as in a and b. Post operation. Eventration of colon, small bowel, stomach and spleen in left side of thoracic cavity completely collapsing lung. Left kidney is retropleural. (Courtesy *American Journal of Surgery* 3)



intrathoracic pressure and thoracic visceral relationships surgical intervention should be instituted as soon as possible because of the danger of intestinal obstruction. If nourishment can be maintained, it is well to delay operation for 2 to 3 months after birth in order to permit some development of their necessary respiratory mechanism. If operation is delayed for too long a period, the abdominal viscera will have lost their right of residence in the abdomen. By this I mean that the abdominal cavity will not have developed sufficiently to contain them and there will be marked increase in the intra-abdominal pressure when the viscera are replaced into the abdomen.

In repair of small hernias of this type the opening can be closed without interruption of the phrenic nerve. On the other hand in repair of large hernias interruption of the phrenic nerve is a necessary procedure. Each opening is closed by overlapping the margins for from 2 to 3 centimeters. If the patient is an infant, this closure is made with interrupted silk sutures. Before the opening is com-

from them die in the first few hours or days of life because of respiratory and cardiac embarrassment and before surgical intervention can be instituted. In treating those infants who are able to survive in spite of the abnormal

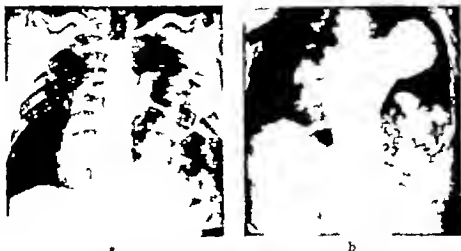
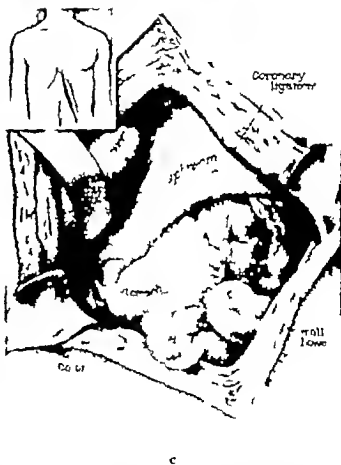


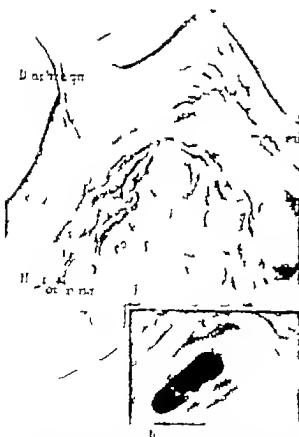
Fig. 12. Patient aged 47 years. a, On admission. Entire left side of thoracic cavity is filled with hollow viscera displacing mediastinum to right. Complete collapse of left lung. b, Entire stomach in left side of thorax extending to second rib. Mediastinum is displaced to the right. c, Conditions found at operation. Herniation of the entire stomach, colon, small bowel and spleen through large laceration in left posterior hemidiaphragm. Viscera were adherent and compressing left lung. (Courtesy Western Journal of Surgery 2)



There is some difference of opinion as to whether this type of hernia should be classified as congenital or acquired hernia. It is impossible to explain its occurrence on a basis of faulty fusion or improper disposition of the embryonic mesodermic elements which go to form the diaphragm, as this anterior portion of the diaphragm is derived from the septum transversum only. But the consistency of the location of the hernial opening, the fairly constant relation of the neck of the hernial sac to the round and falciform ligaments of the liver and the frequency with which the hernial sac protrudes into the right side of the thoracic cavity at the same point of entrance at the cardiophrenic angle, as well as the often associated nonrotation of the right portion of the colon, all strongly suggest a fundamental embryologic basis. These hernias are essentially direct hernias through a congenital defect in the structure of the diaphragm or faulty attachment of the diaphragm to the sternum and costal cartilages. The constant presence of a peritoneal sac shows that the peritoneum had closed off the abdominal cavity from the pleural cavity before the actual herniation of the abdominal viscera occurred.

Subcostosternal diaphragmatic hernia is one of the two types of diaphragmatic hernia in

my experience which have an hernial sac. The other type is that through the esophageal hiatus. It is interesting that subcostosternal hernia is probably the rarest type of diaphragmatic hernia and esophageal hiatus diaphragmatic hernia is the most common, both are essentially congenital in origin but are rarely present at birth and occur in most instances in later life because of increased abdominal pressure on a congenitally defective diaphragm.



closing this large gap in the diaphragmatic muscle and of reconstructing the attachment of the diaphragmatic muscle to the thoracic wall. In some instances the posterior peritoneal fascia may be utilized in this closure and fixa-

tion to the thoracic wall. If the gap is not too great the closure can be accomplished by complete permanent interruption of the phrenic nerve. If the defect is too large to permit the relaxed diaphragm to span the gap it is necessary to shorten the diameter to the diaphragm by extrapleural resection of ribs.

In 12 cases in my series (Table 1) the hernias were due to congenital absence of a portion of the diaphragm. There were one recurrence and two deaths.

Subcostal hernia through the foramen of Morgagni (Larrey's spaces). Herniation of abdominal viscera through regions of deficiency of muscle in the anterior portion of the diaphragm close to the sternum has received various names such as diaphragmatic hernia through the foramen of Morgagni or through Larrey's fissures or spaces and also substernal retrosternal parasternal or anterior diaphragmatic hernia.

Inasmuch as hernias of this type may occur anteriorly on either side of the midline if an anatomic term is to be used it would be preferable to designate them as subcostosternal diaphragmatic hernias.

cur if there are no subjective symptoms to suggest that an abdominal condition may be present and even though the gastrointestinal tract is examined roentgenologically, no lesion is demonstrated as no abdominal hollow viscus is involved in the hernia. One of the most important clinical considerations in this type of hernia is the possibility of this erroneous diagnosis.

The treatment of subcostosternal hernia is surgical closure of the abnormal opening in the diaphragm after replacement of the abdominal viscera into the abdomen. I prefer an abdominal approach through the upper part of the right rectus muscle because the opening in the diaphragm is accessible and the abdominal contents of the hernia are more safely and easily reduced from the abdominal than from the thoracic side of the diaphragm as the true relationship of the herniated viscera to the hernial sac can be determined accurately.

The method of closure of the neck of the sac and of the defect in the structure of the muscle of the diaphragm depends on the size and character of the opening. Small linear openings may be closed by overlapping the margins. Larger transverse openings extending beneath the sternum are best closed by suturing the anterior margin of the defect in the diaphragmatic muscle to the posterior sheath of the rectus muscle and to the anterior wall of the thorax.

The most satisfactory material for closure of the opening is living suture of fascia lata removed from the thigh and stabilized in the tissues with silk. The round ligament of the liver can be incorporated in this closure to strengthen it as well as to re-establish its position on the anterior wall of the abdomen.

The closure of the large openings is facilitated by paralyzing the right side of the diaphragm by temporary interruption of the right phrenic nerve. This procedure however is not necessary in the closure of small openings. The phrenic nerve can be interrupted in the supraclavicular region after the opening has been explored and it has been determined whether interruption is necessary.

In my series of 430 cases of diaphragmatic hernia, 8 were of the subcostosternal type.

There were no deaths or recurrences following operative treatment.

TRAUMATIC DIAPHRAGMATIC HERNIA

Traumatic diaphragmatic hernia may be caused by direct or indirect injury or by inflammatory necrosis of the diaphragm. In case of indirect injury of the diaphragm, the hernia may occur at any point, including points of embryologic fusion but the most common sites are the dome and the posterior half of the left part of the diaphragm. On the other hand the hernia may occur in the right part of the diaphragm. It usually is the result of a severe, crushing injury. When the hernia occurs through the esophageal opening there is a sac but when it occurs through the leaf of the diaphragm, there usually is no sac. In case of direct injury to the diaphragm the hernia may occur at any point and is usually the result of penetrating wounds such as those inflicted by a gun or knife.

Rupture of the diaphragm may be the result of inflammatory necrosis, which in turn has been caused by subdiaphragmatic abscess. Again, rupture may follow necrosis caused by drainage tubes which have been introduced into empyemate cavities. In these cases the opening usually is situated in the posterior part of the diaphragm and there is no hernial sac.

Traumatic diaphragmatic hernias usually do not present the difficult diagnostic problems which are associated with the esophageal hiatus type of hernia for the occurrence of the injury leads the physician to suspect the possibility of a hernia, except in cases of inflammatory necrosis. The symptoms associated with the traumatic type of hernia progress rapidly are severe, and are attributable to the mechanical interference with the function of the herniated viscera as well as to marked interference with function of the heart and lungs. This mechanical interference is due to the fact that there is no hernial sac and the abdominal viscera are in direct contact with the thoracic viscera. The most marked immediate symptoms are usually those of respiratory and circulatory embarrassment. Traumatic hernias are more frequent in adult life, and the compensatory

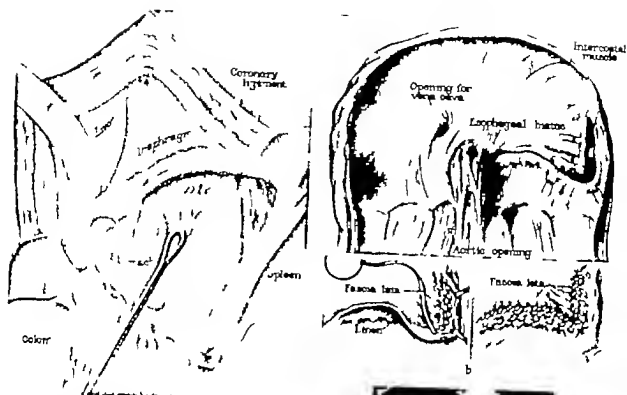


Fig. 3 Same patient. a, Abdominal approach. Left lobe of liver has been separated from the diaphragm. The adherent stomach and spleen are being removed from the hernial opening. b, The triangular laceration in left side of diaphragm is repaired with silk and fascia lata by overlapping and suturing to thoracic wall. c, Two years after operation. Stomach in normal position below the repaired left diaphragm. Left lung is expanded and mediastinum is in normal position. (Courtesy *American Journal of Surgery*, 3, and *Western Journal of Surgery*.)

The abdominal viscera usually involved in the hernia are the colon omentum ileocecal coil and rarely the stomach.

The symptoms associated with these hernias are often indefinite and depend on the type and amount of abdominal viscera involved in the hernia. They are usually due to impairment of respiration and intestinal obstruction. Among them are dyspnea, cough, and attacks of partial intestinal obstruction and thoracic and abdominal pain.

In the cases in which hollow viscera are involved in the hernia, symptoms occur which suggest the possibility of an hernia or at least the necessity of a roentgenologic examination of the intestinal tract which will determine whether an hernia is present. The cases in

which omentum only is involved in the hernia present a much more difficult diagnostic problem. The symptoms in this type of case are entirely referable to the thorax as a result of the mechanical interference with respiration and expansion of the lungs. These symptoms suggest a primary pulmonary lesion and direct the clinical investigation to roentgenologic study of the thorax. The roentgenologic findings of an increased density in the pulmonary field justify the clinical diagnosis of a primary intrathoracic lesion which may be thought to be an intrathoracic tumor (Fig. 11). This erroneous diagnosis is particularly likely to oc-



In all traumatic hernias through the left side of the diaphragm, I prefer the abdominal approach through an oblique left rectus incision. The herniated viscera are usually adherent to both the abdominal and the thoracic side of the diaphragm and to the structures within the thorax. The adhesions to the margins of the opening and to the under surface of the diaphragm are often extensive and should be separated first. The adhesions to the structures within the thoracic cavity are separated from below upward by approaching them through the hernial opening. The abdominal approach permits this separation of adhesions with little danger of injury to the abdominal or thoracic viscera, because the definite relationship of the herniated structures can be established.

When considerable structure has been lost or the muscle has been torn from its attachment to the thoracic wall the defect in the diaphragm should be repaired by fascia lata stabilized with linen sutures. I believe this to be the most satisfactory type of closure in all these cases. In cases in which the laceration is confined to the dome of the diaphragmatic muscle it usually is advisable to repair the opening by lapping the anterior over the posterior margin. When possible it is advisable to overlap the margins of the opening for from 2 to 3 centimeters. In those cases in which the muscle of the esophageal ring is split great care should be taken in repairing the esophageal hiatus. In cases in which the laceration extends to the margin of the thorax and in which the attachments of the diaphragm are torn from the thoracic wall repair is made by overlapping the lacerated edges of

the leaf of the diaphragm and by resuturing the diaphragmatic muscle to the thoracic wall. This can be accomplished by suturing the diaphragmatic muscle to the intercostal muscles. When possible the diaphragmatic muscle should span two interspaces fixed to the intercostal muscles with fascia lata and made stable with interrupted linen sutures.

In a few instances the relaxation of the diaphragmatic muscle caused by interruption of the phrenic nerve will not be sufficient to permit repair of the defect. In these cases the diameter of the thorax must be narrowed by resecting the lower ribs. It is usually not necessary to resect more than a few inches of the eighth, ninth, and tenth ribs at the angles.

Before the abdomen is closed the herniated viscera should be thoroughly explored to be certain that there has been no injury to a viscus and that there are no bands of adhesions which will interfere with their function. In cases in which there has been considerable obstruction of the large bowel it may be necessary to perform appendicectomy or colostomy at the time of operation.

In my series of 58 cases of traumatic diaphragmatic hernia there were no recurrences and 5 deaths.

RESULTS

In Table II the surgical procedures and operative results in the entire series of 430 cases are given.

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TABLE II —SURGICAL PROCEDURES AND OPERATIVE RESULTS IN 430 CASES

Radical repair of defect in diaphragm	397
Abdominal approach	393
Thoracic approach	
Preliminary interruption of phrenic nerve.	204
Preliminary extrapleural thoracoplasty	4
Operations in conjunction with repair of hernia	
Gastric resection	
For gastric ulcer	
For carcinoma	
Total	3
Closure of perforated gastric erosion (total erosions, 37)	1
Gastroenterostomy	
For gastric ulcer	1
For duodenal ulcer	1
Total	3
Splenectomy	
For tuberculosis	1
For injury	3
Total	0
Appendicectomy for obstruction	
Appendicectomy for appendicitis	3
Interruption of left phrenic nerve (hiatus hernia)	
Palliative	7
Therapeutic	26
Total	33
Total patients operated on	430
Recurrence of hernia	
Traumatic hernia	
Congenital defect	
Esophageal hiatus	9
Types of recurring esophageal hiatus hernia	9
Röntgen diagnosis without symptoms	5
Röntgen diagnosis with recurrence of symptoms	4
(Repair of recurrent hernia, 4)	
Operative deaths on basis of 430 cases	7 (4.0 per cent)

cardiac and respiratory reserve usually carries the patient over the acute symptoms if the other associated injuries have not been too great. Later severe hemorrhage from the gastrointestinal tract may occur as a result of incarceration or strangulation of the hollow viscera. If the patient survives the acute condition the later symptoms depend on the viscera involved. The symptoms and signs may consist of obstinate constipation, large quantities of gas in the colon, and attacks of partial or complete intestinal or gastric obstruction. The sudden onset of symptoms in cases of hernia caused by direct or indirect trauma usually is related directly to the injury and there is rarely a question as to the clinical diagnosis. Surgical treatment is demanded because of the

danger of cardiac and respiratory failure or because of intestinal strangulation.

In those types of diaphragmatic hernia which result from inflammatory necrosis of the diaphragmatic muscle the symptoms of hernia are often somewhat obscured by those due to the primary illness. In many instances their true cause is not recognized for a long period because the possibility of a hernia is not considered. In some cases the hernia does not occur for many months after the patient recovers from the primary illness.

Hernias due to direct trauma demand immediate surgical treatment if there is any indication of an associated injury to the hollow viscera. In cases in which the hernia is caused by indirect injury there is less likelihood of a rupture of a hollow viscera and operative interference may be delayed until the acute symptoms caused by the primary injury have subsided; however operation in these cases should be done as soon as possible because of the danger of the occurrence of intestinal obstruction. It is important that the delay should not be long because the herniated abdominal viscera will lose their right of residence in the abdomen. When the protrusion of abdominal viscera into the thoracic cavity is of large size and has lasted for a long time, the herniated viscera become dilated because of mechanical interference to their normal functions and the abdominal cavity which has not contained them for a long time becomes smaller. These factors tend to increase the hazard of operation as well as the risk of recurrence of the hernia, because when these viscera are replaced into the abdomen they markedly increase the intra abdominal pressure.

The surgical approach in traumatic hernias may be through the thorax or through the abdomen. For all hernias through the right side of the diaphragm I prefer the thoracic approach because the large right lobe of the liver interferes with exposure of the right side of the diaphragm if the abdominal approach is used. In hernias of this side the right lobe of the liver is often incorporated in the hernia and its reduction is accomplished more safely when the thoracic approach is used (Figs. 12 and 13).

Beginning nearly a decade ago, attempts were made in the laboratory to develop methods of working on the thoracic aorta with a reasonable degree of safety. Using medium or large sized dogs it was found possible to resect one or two centimeters of aorta and to anastomose the remaining ends for re-establishment of the aortic pathway. Numerous methods of vessel suture were tried and all were discarded in favor of that which employs a continuous mattress stitch of fine silk the suture traversing all layers of the vessel wall and bringing the vessel ends together so that intima comes to intima and the arterial ends are everted. In spite of the large size of the vessel, the great tension on the suture line (because of the aortic elasticity) and the high blood pressure which must be carried by the structure, healing and solid union at the suture line could be expected. On theoretical grounds it would seem preferable to anastomose aortic ends by careful layer to layer approximation (intima abutting to intima, media to media etc.) but our experiments showed this to be followed occasionally by disruption or poor healing. (This method was subsequently employed by Crafoord for use in human subjects but I am firmly convinced that it is less reliable than the everting type of repair.)

From the laboratory certain lessons have been learned which, when augmented by other knowledge can be translated into a practical procedure for removal of aortic constrictions from humans. Exposure through the back must be adequate it is apt to be difficult and bloody because of the great collateral circulation which is encountered in the chest wall. A segment of aorta, 8 to 10 centimeters long must be mobilized from its bed with extreme delicacy and care. To avoid serious hemorrhage the large, thin intercostal arteries must be handled gently

particularly at their junctions with the aorta which are points of extreme weakness and vulnerability. Most coarctations involve only a short segment of vessel and there is sufficient elasticity in the remaining portions of the aorta to allow excision of the constricted part and anastomosis of the remaining ends.

Throughout the operation and in spite of liberal use of hemostats and sutures, there may be considerable blood loss from the transected muscles, rib beds etc. An occasional check on the total loss by measuring the fluid in the suction apparatus and by weighing of discarded sponges provides a satisfactory guide for blood infusions. In this way shock is not treated it is prevented. During closure of the chest, complete re-expansion of the left lung will insure returning the patient to a normal physiological state as quickly as possible. During the first week or two after operation there is usually sufficient collection of fluid in the left pleural cavity to require tapping. It is not necessary to give these patients anticoagulents during the postoperative period, the performance of an extremely accurate anastomosis is the best way of avoiding thrombus formation at the suture line.

In a series of forty personally treated patients with coarctation ranging in age from 7 to 31 years the following results were obtained. The thoracic duct was not injured in any case. In five instances only exploration was carried out the operation was terminated because the narrowed segment of aorta was very long, or else the vessels were surrounded by an inflammatory reaction as a result of previous infection. In thirty five cases the narrowed portion of aorta was excised and the remaining ends of the vessel were brought together. There were five deaths in this group some of which

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SURGICAL TREATMENT FOR COARCTATION OF THE AORTA

CONGENITAL obstruction of the thoracic aorta may so impede the peripheral flow of blood that the left ventricle is overworked and may fail in early infancy. Cardiac failure in the newborn period is particularly apt to occur if the heart itself possesses severe malformations. If a human with coarctation of the aorta lives beyond infancy there lies beyond this an uncertain future. In an effort to determine the prognosis for patients with coarctation of the aorta pertinent data have been obtained by my colleagues who made an extensive search of autopsy records in the regional hospitals, including in the study all subjects who were found to have a coarctation at postmortem examination, whether or not the anomaly had contributed to the death. All cases were discarded in which there was a fatality within the first two years of life hoping thereby to exclude the more compli-

cated forms of cardiovascular abnormalities. For those subjects who lived for more than two years, certain generalities can be stated regarding the prognosis. The abnormality was much more common in men than in women. The patients could be placed into four groups of about equal size. In the first quarter were those who had lived a long life—some to well advanced years—and who had had little or no important complaints related to the vascular obstruction. In the second quarter were those who had died suddenly from aortic rupture. This fatal complication was most common in the third decade of life. In the third quarter were those who had died from superimposed *Streptococcus viridans* infection a complication which was most common during the second and third decades. Such infection is of course much less of a threat in the present day of chemotherapy. In the fourth quarter were those who had died of the hypertensive state—from cardiac failure or from intracranial hemorrhage. While intracranial hemorrhage was sometimes encountered in childhood deaths from cardiac failure or intracranial bleeding were most common in the fourth decade. The serious nature of coarctation can be indicated by studying the death rates in humans between the ages of 15 and 30 years. In the general population fatalities in this age range are uncommon in contrast, about forty per cent of patients with coarctation die within this same period of life. Certainly coarctation of the aorta is attended by crippling or fatal sequelae in a high proportion of cases and thus demands the surgeon's attention in devising methods for averting these catastrophes.

ing that occurs through the interventricular septal defect where the flow is from right to left and venous blood from the right ventricle passes out into the overriding aorta directly into the systemic circulation

Arterial oxygen saturation is a direct function of the total mixed venous blood which passes through the lung. A decrease in pulmonary capillary flow existing with intracardiac shunts contributes to arterial oxygen saturation only by reducing the effective pulmonary blood flow. A large right to left shunt will cause anoxemia for the same reason. However as Bing and his associates have pointed out, in uncomplicated pulmonic stenosis where there is simply reduction in pulmonary flow arterial oxygen unsaturation is not produced since in such a case all the mixed venous blood reaches the alveolar capillaries.

Congenital abnormalities of the heart have assumed a particular importance in medical and surgical practice since Blalock and Taussig's significant contribution in May 1945. Taussig emphasizes certain characteristic clinical findings that are helpful in establishing the diagnosis of the tetralogy of Fallot: to wit, the heart is normal in size and usually a basal systolic murmur and pure second sound are audible. The electrocardiogram shows a right axis deviation. The x ray demonstrates an absence of the normal fullness of the pulmonary conus and the lung fields are clear. Fluoroscopy shows no pulsations at the hilus of the lungs.

This same seasoned observer (Taussig) admits there are many variables in the clinical findings. The systolic murmur may be quite loud or entirely absent! The second sound may be diminished or accentuated; it is never reduplicated. Cyanosis may be marked or slight, depending upon the degree of the oxygen unsaturation and the height of the red blood count. The exercise tolerance of the in-

dividual shows a corresponding variation; some persons can walk a mile, some not at all.

Two additional methods of examination have been developed to render more exact the diagnosis of congenital cardiac defects. The Robb-Steinberg technique of angiocardiology provides excellent visualization of the chambers of the heart and great vessels. Particularly is this the case in children of the younger age group. Overriding of the aorta, small or large pulmonary arteries, marked cross chamber filling and right or left sided aortic arches can all be demonstrated by this type of examination. Retrograde injection of diodrast solution through the left common carotid artery can be used as a visual method to demonstrate patent ductus arteriosus and coarctation of the aorta.

Venous catheterization of the heart is the other important method that is helpful in the diagnosis of congenital heart malformations. Blood samples can be obtained via the catheter and the oxygen content of these samples determined. In addition pressure measurements can be accurately determined by the same route. The catheter is manipulated under fluoroscopic guidance and the presence of a septal defect can often be visually determined by actually passing the catheter through the defect. Cournand and Ranges were the first in this country to demonstrate the value of venous catheterization of the heart. Cournand has reported 1,200 such examinations with no fatalities or serious complications. Bing and his associates and Sossman and Dexter and others have contributed valuable information in their publications on physiological studies in congenital heart disease.

Anastomosis of one of the major systemic arteries to the right or left pulmonary artery is often spoken of as the Blalock operation. Blalock and Taussig have advocated this oper-

can be regarded as avoidable in the light of surgical experience which has been obtained subsequently. Specimens removed from the thirty five patients showed a complete block in five and in the remainder there was a tiny opening only one to three millimeters in diameter. In patients surviving removal of a coarctation follow up studies show that there has been no relief of hypertension in one (in whom the anastomosis was known to be poor) whereas, in all other cases there has been an extremely gratifying fall in the arm pressures to normal levels. Concurrent with lowering of arterial pressure in the arms there has been an increase in pulsations in the legs and lower part of the body and a rise in arterial pressures of the legs. In the early part of our work there were apprehensions about the possibilities of a renal ischemia factor the existence of which would prevent a fall in general arterial pressure throughout the body even though an aortic obstruction could be removed surgically. Such fears can now be dispelled because ample evidence has accumulated to show that surgical restitution of a normal aortic pathway will be followed promptly by normal pressure relationships throughout the body.

In these operations certain age restrictions as yet not clearly defined must be necessary because of technical considerations. Below six or seven years the aorta is probably too small to work upon with facility and satisfaction. Above twenty five or thirty years the vessel is apt to be sclerotic above the obstruction or else thinned out below the constriction. If such vessel changes are marked they will militate against surgical excision of a coarctation or will greatly increase the risks of such an undertaking. The optimum ages for procedures of this sort appear to lie between ten and twenty years. This fact points to the great desirability of recognizing

the malformation in young subjects, particularly when it is the cause of hypertension, because in the second decade of life will the surgeon have the best chance of restoring the aortic channel to normal.

These operations are time-consuming and difficult for the anesthetist, the surgeon and the entire team yet a meticulous dissection and technique must be constantly employed. Any careless movement of hand or instrument may cause serious damage to the aorta or one of its tributaries or indeed result in uncontrollable hemorrhage and sudden death. For those who would engage in this type of surgery it is not only necessary to have an intense interest in vascular as well as thoracic surgery but in addition it is essential to practice the maneuvers thoroughly on human cadavers and on living animals before undertaking the reparative procedures on human patients. The aorta has long been regarded as sacrosanct and beyond the surgeon's knife but it is now clear that a knowledge of aortic pathology and a development of special techniques make it possible to correct the most common malformation of this great vessel.

ROBERT E. GROSS

CONGENITAL PULMONARY STENOSIS

THE most frequently encountered type of congenital cardiovascular defect accompanied by cyanosis is termed the tetralogy of Fallot. The four features that constitute the tetralogy of Fallot are pulmonary stenosis or atresia, dextroposition or overriding of the aorta, an interventricular septal defect and right ventricular hypertrophy. This malformation results in a greatly diminished flow of blood through the pulmonary artery. Cyanosis and clubbing of the fingers are due to the venous-arterial mix

sulfonamides and the antibiotics. Third we must consider what damage these agents may do either to the local tissues or the body as a whole. Let us first review the fundamental differences between medical and surgical infections. With medical infections there is a diffuse cellulitis of the organ involved but there is no local destruction of tissue. With surgical infections the disease is usually local and there has been a local breakdown of tissue or a local collection of exudate. It is obvious that medical infections can seldom be treated locally but are best served by some medication which can permeate the tissues of the body and may then be expected to reach the areas of infection through patent and generally dilated blood vessels. In surgical infections, an opportunity is given for local as well as systemic treatment. Medication can often reach infected areas by local treatment when it cannot reach these areas by systemic treatment because of thrombosis of the blood vessels in the periphery of the local lesion. It goes without saying that an infection can be most quickly controlled by bringing the antibacterial agent into contact with the infecting organisms as quickly as possible in the highest concentration that can be tolerated by the tissues of the host. It would seem obvious that in the treatment of surgical infections this can best be accomplished by smaller quantities of the medicine applied locally than those which are required for systemic administration since so much of the latter is lost by its rapid elimination and its uptake by the tissues of the body which are not affected. The local effectiveness of the sulfonamides and the antibiotics or any other antibacterial agent is limited (1) by its solubility in body fluids, (2) by its diffusibility from the vehicle in which it is applied (3) by its inhibition by dead tissue, pus, blood or any other product of tissue disintegration (4) by the inactivating action

of bacterial contaminants and (5) by the resistance of the causative organisms.

It is true that the sulfonamides in general with the possible exception of sulfamylon are inhibited by necrotic tissue and by organic acids which are present in exudates. Furthermore they are relatively insoluble so that they may act as foreign bodies and be mechanically irritating. This is particularly true of sulfon-thiazole and sulfadiazine. On the other hand penicillin, streptomycin and bacitracin are not inhibited by necrotic tissue, pus, or blood are highly soluble and diffusible and if they are introduced in a watery solution or in a water soluble vehicle like carbowax they are available for their antibacterial action and are absorbed through the wall of the local lesion. They are limited only by the resistance of the causative organisms or by the ability of contaminating organisms to produce inactivating ferments. Penicillin seems to be entirely without toxicity even in large doses except for rare cases of idiosyncrasy, but the dermatologists are finding that many individuals develop a sensitivity to it after prolonged application in ointment form. Penicillin's chief limitation is its destruction by penicillinase which is produced mainly by organisms of the coliform group namely *Escherichia coli*, *Pseudomonas pyocyanea*, the aerobacters occasionally by proteus, by certain strains of the *Bacillus subtilis* and by primarily resistant staphylococci.

Streptomycin is not inhibited by these organisms but has a limited spectrum of antibacterial activity. Its chief value is its effectiveness against many gram negative rods as well as certain gram positive cocci and the acid fast bacilli. Its chief limitation is the rapid development of resistance (sometimes within 24 or 48 hours) by organisms which are not killed primarily by high concentrations of the drug. Toxic manifestations limit the dosage and duration of treatment of the strep-

ation to increase the pulmonary blood flow in that there is a definite lack of circulation to the lungs in congenital pulmonary stenosis. The great value of this operation has been demonstrated in several hundred cases that have been managed by Blalock and his associates. In addition to increased pulmonary blood flow Blalock's shunt operation has demonstrated that one of the branches of the aortic arch can usually be connected to a pulmonary artery without encountering insuperable difficulty that cyanotic children withstand anesthetization and temporary occlusion of one pulmonary artery and that the subclavian artery can be divided within the thorax and the collateral circulation to the affected extremity remains adequate.

Blalock prefers an end-to-side union of the subclavian artery to one of the pulmonary arteries. The subclavian branch of the innominate artery is the vessel of choice in that this vessel makes a less acute angle with its parent artery after the anastomosis is performed. The thoracic incision is made on the side opposite to that on which the aorta descends. The aorta descends on the right rather than the left in approximately twenty per cent of the cases of the tetralogy of Fallot. The innominate artery arises on the side opposite to that on which the aorta descends.

Potts and his group have employed lateral anastomosis between the left pulmonary artery and the thoracic aorta. The size of the shunt can be accurately measured by this method and in addition a union between the aorta and the pulmonary artery may be technically simpler in patients past twenty years of age. When a patient has attained most of his growth the gap to be bridged is greater in proportion to the length of the artery.

Holman uses the subclavian artery that arises as a single trunk from the arch of the aorta. If kinking occurs at the origin of the

subclavian artery Holman then divides the pulmonary artery on the heart side of the anastomosis and corrects the kinking by this maneuver. Holman's method may prove a valuable refinement in that it is associated with the least technical difficulties of the three methods of vascular union.

The results of the shunt operation in congenital pulmonary stenosis are immediate improvement in the patient's color, prompt rise in the oxygen saturation of the arterial blood and gradual fall in the red blood count, hemoglobin and hematocrit. It is not possible to say how much the patient's life span is increased but as Taussig says, certainly the patient's enjoyment of life is greatly increased. Perhaps the worth of Blalock's and Taussig's contribution in the management of congenital pulmonary stenosis is best expressed by this note from the mother of a cyanotic child upon whom the Blalock procedure had been performed. "There are no words to express our feelings of gratitude and happiness for making it possible for our little boy to be well and happy and able to play as other children."

H BRODIE STEPHENS

THE TOPICAL USE OF ANTIBIOTICS IN ESTABLISHED SURGICAL INFECTIONS

DURING recent years there has developed a conflict of opinion with regard to the local use of antibiotics in the treatment of infections. I believe that it is possible to resolve this conflict and arrive at a consensus if we can properly classify those cases which can best be treated by systemic administration, by local administration or by a combination of these two.

We must consider first the nature of the infections which surgeons have to treat and second what can be accomplished by the

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REVIEWS OF NEW BOOKS

IN the publication *The Practical Nurse*¹ one finds authoritative information on this widely discussed subject. The findings presented as a result of the writer's investigations and the use of material found in studies conducted by national groups give one a comprehensive picture of the situation. In the preface Miss Deming states that this book attempts to show that a new and desirable kind of practical nurse can be developed who will be a partner of the registered nurse—and a welcome one—in giving care to the sick at home and in all types of hospitals.

It is pointed out that something must be done to provide more adequate care for patients in hospitals and homes, for the mentally ill, the chronically ill and the aged. That there may be no misunderstanding regarding the term "practical nurse" the following definition is found in chapter II. The name practical nurse refers to a person with specified training of nine to eighteen months licensed in the state in which he or she is practicing if a state law exists and serving in homes, hospitals, public health or industrial agencies under the direction of a licensed physician and—desirably—the supervision of a professional registered nurse. It is explained that the duties and responsibilities of the licensed practical nurse vary greatly; however a person qualified to meet licensure requirements recognizes the protection which is inherent in a limitation of her duties.

In hospitals and other institutions, the practical nurse has the benefit of supervision of the professional nurse, while in public health and other agencies supervision may be more limited. The guidance and supervision should be such that the practical nurse has a feeling of sharing in the responsibilities. Those employed in the homes work largely under the direction of a physician who can not be expected to follow the details of nursing care, and in this field more than any other there is the need for the licensed practical nurse.

The author emphasizes the need for uniformity of educational standards in schools of practical nursing and the importance of having a well correlated program of theory and practice. Only when and where adequate facilities are available should efforts be made to establish schools of practical nursing which meet accreditation requirements. Then the next step is to make provisions for licensure, and we are warned not to travel ahead of the public's understanding of this new phase in the development of practical nursing care. A well publicized campaign

for licensing the trained practical nurse and vigorous efforts to make clear the difference between the two types of nurses should precede the production of thousands more non-professional nurses. At present, it is not quantity so much as controlled quantity that we need in the field of practical nursing. It is recognized that an intensive educational program must first be carried on in the professional nurse and practical nurse groups. The author pleads for vision which sees through all the veils of habit and tradition by which we are walled in to the real need of the human beings in our communities and the courage to follow that vision and meet those needs.

The list of references accompanying each chapter is especially valuable and should be used by the reader who is uninformed. We have needed such a book for a long time. Because of Miss Deming's varied experiences she is able to present a broad viewpoint and *The Practical Nurse* should be widely read by the professional registered nurse, the practical nurse, the physician and the hospital administrator.

MARY I. BOGARDUS

THE monograph *Hodgkin's Disease and Allied Disorders*² contains chapters on Hodgkin's disease, reticulum cell sarcoma, lymphocytoma and lymphoblastoma, lymphosarcoma, giant follicle lymphoma, histiocytoma and endothelioma. The pathological, clinical and therapeutic aspects of these diseases are thoroughly dealt with; the rich material supplied by the Boston City Hospital, the Collis P. Huntington Memorial Hospital and the Pondville Hospital, being used as bases for discussion. X-ray therapy is discussed briefly without giving dosages because the authors believe that the details of treatment are best carried out by the radiologist. Excellent photomicrographs of the pathologic lesions, and photographs of patients and roentgenograms illustrate the text. A recent photomicrograph of a lymph node from one of the original cases studied by Hodgkin at Guy's Hospital in 1888 is used as an appropriate frontispiece.

Doctors Jackson and Parker have put a wealth of statistical data into their book and for this reason alone it will be consulted as a helpful reference work for a long time. Like all books which describe diseases of unknown etiology it expresses many viewpoints about which there will naturally be dif-

¹THE PRACTICAL NURSE. By Dorothy Deming, R.N. New York: The Commonwealth Fund, 1947.

²HODGKIN'S DISEASE AND ALLIED DISORDERS. By Henry Jackson, J. A.B., M.D. and Frederic Parker, J. A.B., M.D. New York: Oxford University Press, 1947.

tomyacin which is presently available for systemic use

Bacitracin is not inhibited by any organisms which produce penicillinase. There has been no evidence of local irritation or general toxicity from the local application of bacitracin in over 186 cases of surgical infections. Organisms build up resistance to it slowly in about the same degree as they do to penicillin. It has an antibacterial spectrum similar to penicillin but there are many organisms which are susceptible to it and which are resistant to penicillin. With the relatively impure bacitracin now available there are certain toxic symptoms which limit the dosage but it is believed and expected that these will be eliminated when purification has been completed.

It is not unnatural that those who had war experience failed to see any convincing proof or benefit from local application of either the sulfonamides or penicillin because of the nature of the infections which they had to treat. War wounds are characterized by extensive destruction of tissue which inactivates the sulfonamides and extensive contamination with soil organisms which almost invariably include many gram negative rods that are able to produce penicillinase and thus break down penicillin. These are often pathogenic locally in a wound without invading the body and they may interfere with the local effectiveness of penicillin without interfering with the benefit which may be derived from systemic administration against other more invasive organisms that may be present in the wound.

The last point which I wish to stress is the necessity for determining at the earliest possi-

ble time the organisms which are present in any surgical infection which one has to treat. More than half of them will be found to be due to a mixture of organisms. These must be tested for susceptibility to the agent which one desires to use and for the ability of any of the organisms to inactivate this agent. It is obvious that the patient will receive the best treatment if the surgeon, with the aid of the bacteriology laboratory obtains this information as soon as possible and treats the infection with the agent or a combination of agents best suited to meet the situation. If the lesion is local without any evidence of general spread, it can be treated best by local application only. If there is evidence of a spread of the infection into the surrounding tissue or into the body as a whole systemic administration must also be used.

I am not unmindful of the necessity at all times of maintaining the body as a whole at the highest possible physiological level in order to combat infections nor of the frequent necessity for removing dead tissue, particularly necrotic bone or slough before or at the same time as the local application is made of the appropriate antibacterial agent or combination of antibacterial agents.

Antibiotics may be applied locally either in solution in concentrations of 250 to 1000 units per cubic centimeter or in water soluble ointments in concentrations of 250 to 1000 units per gram of ointment. Usually a treatment once or twice a day is adequate and such treatments can often be carried out in the doctor's office upon an ambulatory patient.

FRANK L. MELENEY

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ferences of opinion. Nevertheless the questions raised by these differences of opinion are ones which may be properly asked for they may well stimulate others to discover the answer.

Most of the book is devoted to a consideration of Hodgkin's disease of which a very full account is given. Of considerable interest is the author's division of Hodgkin's disease into three groups: (1) Hodgkin's paraneoplasia, (2) Hodgkin's granuloma and (3) Hodgkin's sarcoma. They describe differences in the clinical symptoms in the pathologic lesions, and in the prognosis of these three forms of Hodgkin's disease which if verified by other workers, will prove a useful contribution to our knowledge of the disease. However one wonders why the authors have not separated Hodgkin's sarcoma entirely from this group since according to their criteria it appears to be a separate disease unrelated to the others.

The morphology of the characteristic giant cell of Hodgkin's disease is somewhat vaguely described and is not clearly distinguished from some of the other types of giant cells which may be found in the lesions. The criteria for attributing the primary site of the disease to various organs are not plainly set forth in the text nor the legends of the statistical tables.

The discussions of reticulum cell sarcoma, lymphocytoma and lymphoblastoma and lymphosarcoma are of interest, but one wishes that the author's classification and findings had been compared with those of Robb-Smith, Callendar and other workers. It would be helpful to know the counterparts in these other classifications of the lesions described in this book. There is a good description of primary reticulum cell sarcoma of bone.

This book should certainly be read by everyone who has to diagnose and treat patients suffering from these diseases, for while one may differ with some of the opinions expressed by the authors, nevertheless it is a mine of valuable information.

WILLIAM B. WARTMAN.

A NEW approach to the recognition of illness is presented in the reference book¹ of nearly seven hundred pages by two highly qualified clinicians and teachers. The authors find from statistical surveys of the leading causes of disability and death, that approximately two hundred diseases account for 98 per cent of all the disability in this country.

In the first section of the book, one finds a detailed analysis of 16 common symptoms, 33 leading physical abnormalities, and 6 essential laboratory tests which will serve as keys to the differential diagnosis of these two hundred diseases. A limited number of additional procedures are recommended to confirm the indicated diagnosis.

In part II the common symptoms of disease are each considered separately from the standpoint of

elicitation, pathologic physiology and differential diagnosis indicated.

The chapters in part III include the physical findings of inspection, auscultation and palpation. Various lesions of the skin, eye, oral mucous membrane, and uterine cervix are illustrated in excellent colored plates.

Part IV is devoted to the diagnostic implications of the small number of essential laboratory procedures.

Part V describes the differential diagnosis of the statistically important diseases grouped by anatomic regions.

There is no royal road to accurate diagnosis, and this book is not a substitute for standard medical works. As a text to read one soon becomes lost in a maze of charts and outlines. As a reference book for the practicing physician, it is the finest this reviewer has encountered. Printed on high quality paper in two columned bold type, it is easy to read and extremely practical in application.

EDWARD W. GUNN.

AS stated in the preface to *The Pathology of Traumatic Injury*² by James V. Wilson the author's aim has been to draw up in one place a summary of the pathological effects of trauma, stating that his work is not to be considered a complete catalogue of the literature upon this subject, but "has been produced during the stress of war while the author has been abroad." This apology seems superfluous when it is found that the reference number 555 titles. However as he states "the work is complete enough for the physician or surgeon, returning from the war anxious to apply the lessons learnt to the treatment of accident cases and it may be a guide to rational treatment."

The text is divided into two parts: the first dealing with the general and specific reactions of the body to various types of trauma while the second considers the special morbid anatomy and physiology of regional injury. The meat of the volume lies in the author's successful correlation of the experiences of the two wars with the scientific studies and clinical reports that appeared between the two conflicts. Unfortunately due to early publications of this work after the second war the many valuable studies of that period have had to be omitted. However the author's own vivid description of his observations upon the pathological material of the last war are valuable and extensive.

He correctly states that the mass of evidence favors the hematogenic theory of shock, there being no incontrovertible evidence in favor of nervous impulses themselves initiating the shock state. The essential pathogenic alteration is reduced cardiac output and blood flow vasoconstriction thrombosis, and hemoconcentration—all of which result in poor venous return, low blood pressure, further cir-

¹DIAGNOSIS IN DAILY PRACTICE: An Office Routine Based on the Incidence of Various Diseases. By Benjamin V. White, M.D., and Charles F. Geschickter, M.D. Philadelphia, London, and Montreal: J. B. Lippincott Co. 1917.

²THE PATHOLOGY OF TRAUMATIC INJURY. General Review By James V. Wilson, M.D., M.R.C.P. (London), Major, R.A.M.C. (T.). Baltimore: The Williams & Wilkins Co., 1944.

culatory stagnation and the vicious circle of anoxia diminished and abnormal metabolism and circulatory collapse. The reversibility of this cycle for only a certain period is essential in understanding the treatment. Whole blood is properly given the paramount place of importance in treating most types of shock, but plasma, saline and glucose solutions are also recognized to be of value if correctly used in proper proportion to blood to make up the specific deficits in various types of injury. The application of external heat in undue quantities is deprecated the comfort of the patient being stressed. Properly, little mention is made of opiates in the treatment of shock. These substances are unnecessary in profound shock, their indication being to combat restlessness and discomfort in the early phases of conditions likely to lead to shock.

The pulmonary, renal, hepatic, and special organ damages in each type of traumatic injury are extensively described and the special alterations in treatment indicated by these findings are given. For example in burns the profound effects of the complications of infection, anoxia, and marked nitrogen loss are stressed while in the crush syndrome the renal lesions are stressed and in blast injury the pulmonary and abdominal visceral changes are described in detail. The excessive administration of fluid into the venous side of the circulation in these latter two conditions is likely to be dangerous. Up-to-date chapters are included on fat embolism and on wounds and wound infections.

Injuries to the chest, the abdomen, the central nervous system and to the blood vessels command special chapters. It is in these fields that special advances have been made during the past conflict. However much of this newer knowledge has been a reorientation based on the observation of a large and varied material.

The only specific shortcoming in this small volume is an attempt to cover injuries to bones and joints in a small chapter of ten pages. The complications of fractures are described in slightly more than two pages of this chapter. This lack of space occasionally causes the author to lean too heavily upon the experiences of the second World War. An example is the following quotation, which is the closing sentence of the book: "These (the problem of joint resection for motion vs immobilization in treating damaged joints) and other problems may be settled when the final story of the recent war comes to be written."

The author is to be congratulated upon his terse direct style so often found in British monographs.

This small but remarkably well organized volume will be of value to anyone wishing an up-to-date view of the subject of traumatic shock or of the experiences of an expert pathologist with a voluminous material arising from the second World War. It would be difficult to condense the subject material further.

PAUL H. HARMON

A REMARKABLE account of the development of medical research in America, *American Medical Research: Past and Present*,¹ was written by a non-medical historian who has made the history of medical research his specialty.

The field is divided into four epochs. The first or British Colonial epoch, extends to 1820. The second epoch is the result of French influence extending from 1820 to 1860. The third epoch is the result of German influence and extends from 1860 to the end of the century and the fourth epoch in the twentieth century, is independent of any special outside influence. The first and second epochs are in the main devoid of experimental methods which were first imported by Americans who worked in the German clinics and laboratories during the second half of the nineteenth century.

With the remarkable advances in American medical research during the present century has come the construction of great medical centers by both the privately endowed and the state supported universities and, in a few instances the establishment of independent institutes of medical research. An extensive and accurate review of research activities is given in the various branches of preclinical and clinical medicine and the significance of the use of the basic sciences of chemistry and physics in both animal experimental and clinical investigation is pointed out.

It is predicted that there will be greater federal support for medical research in the future because of the outstanding advances made by the use of federal grants during the late war. It is pointed out that just as great emergencies exist in peace time as in war time, and that public opinion would sanction federal support of research against diseases such as cancer which accounts for about four hundred deaths daily.

The book is written without bias and should be worth while reading for everyone engaged in the field of medical research.

DALLAS H. PHENIXTER

AMERICAN MEDICAL RESEARCH, PAST AND PRESENT. By RICH and H. SHRYOCK, Ph.D. New York: The Commonwealth Fund, 1947.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

ARTHUR W ALLEN *Boston President*

DALLAS B PHEMISTER, *Chicago President Elect*

PRELIMINARY PROGRAM FOR 1948 CLINICAL CONGRESS

THE BILTMORE HOTEL LOS ANGELES

OCTOBER 18 TO 22, 1948

PLANS are proceeding for the program of the thirty fourth Clinical Congress of the American College of Surgeons which will be held in Los Angeles at the Biltmore Hotel from October 18 to 22 1948

Representatives of the Los Angeles hospitals which will participate in the clinical program have been holding meetings to further the scheduling of clinics in as nearly final form as possible. A preliminary schedule of clinics, preceded by a list of the hospitals which will participate and the names of the representatives who are responsible for the program at each hospital, follows this article. Twenty five hospitals have so far indicated a desire to participate, and they will arrange their programs to cover subjects in general surgery obstetrics and gynecology fractures, orthopedic surgery thoracic surgery neurosurgery genitourinary surgery and ophthalmology and otorhinolaryngology. Revised schedules will appear next month, and in succeeding months, up to the time of the Clinical Congress. During the Congress Daily Clinical Bulletins will be issued which will give the final clinical program.

The possibility of telecasting operations from one or more of the hospitals is still being explored. The use of television is especially desirable after the exceedingly successful demonstration of its teaching value at the Clinical Congress in New York last year.

The usual varied and comprehensive program of meetings at the headquarters hotel is planned. The opening session will be a General Assembly for both surgeons and hospital personnel on Monday morning. Scientific sessions, official meetings, and hospital conferences will follow during the five-day Congress. In addition to meeting rooms in the Biltmore Hotel, the Biltmore Theater and

the spacious Philharmonic Auditorium across the street from the hotel will be used for the larger audiences. The capacity of the Philharmonic Auditorium is 3 700 and that of the Biltmore Theater about 1 700.

PRESIDENTIAL MEETING

The opening evening session of the Clinical Congress will be devoted to the Presidential Meeting, at which the officers-elect, consisting of Dr Dallas B Pheminster of Chicago as president, Dr Howard A. Patterson of New York as first vice president, and Dr Carl H. McCaskery of Indianapolis as second vice president will be installed. Dr Arthur W Allen of Boston, outgoing president and vice-chairman of the Board of Regents, will preside and will deliver the Presidential Address. The third Martin Memorial Lecture will be delivered by Dr Clarence Crafoord, Professor of Surgery University of Stockholm.

CONVOCATION

The annual Convocation will be held on the final evening, Friday. The formal initiation ceremonies and the presentation of the Fellowship Address by Dr L. A. DuBridge, President, California Institute of Technology Pasadena, will constitute the program. Dr DuBridge's subject will be "The Physician Meets the Doctor."

EVENING SCIENTIFIC SESSIONS—GENERAL SURGERY

"Malignant Lesions of the Thyroid Gland" will be the subject of the Tuesday evening symposium on general surgery. "Pathology" will be discussed by Dr Frank W Foote of New York. "Aberrant Thyroid" by Dr Brien T King of Seattle. "Malignancy in Nodular Goiter" by Dr Warren H. Cole of Chicago and "Radioactive

Iodine in the Treatment of Thyroid Diseases Including Cancer by Dr Myron Prinzmetal, Los Angeles.

Endometriosis will be the subject of the Wednesday evening symposium on general surgery. Three speakers, among them Dr Joe V Meigs of Boston, will discuss, respectively **Significance of Endometriosis**, **Surgical Treatment of Endometriosis**, and **Theories and Medical Treatment of Endometriosis**. The **Fracture Oration** will also be presented at this session.

Surgery of the Heart and Great Vessels will be the subject of the Thursday evening symposium on general surgery. **Surgical Treatment of Pulmonic Stenosis** will be discussed by Dr Alfred Blacklock of Baltimore. **Surgical Treatment of Constrictive Pericarditis** by Dr Emile F Holman of San Francisco. **The Surgery of Patent Ductus Arteriosus** by Dr John C Jones of Los Angeles and **Treatment of Coarctation of the Aorta** by Dr Robert E Gross, Boston.

EVENING SCIENTIFIC SESSIONS—OPHTHALMOLOGY

The preliminary program for the Tuesday evening session on ophthalmology comprises the following three subjects: **Tumors of the Eyelids and the Conjunctiva**, **Partial Keratoplasty** and **Further Studies of the Cytology of Conjunctival Exudates**.

The Wednesday evening program will be devoted to a panel discussion on the subject, **Neoplasms of the Orbit and Nasal Accessory Sinuses** and will be participated in jointly by ophthalmologists and otorhinolaryngologists.

Subjects for the Thursday evening session have not yet been definitely selected.

EVENING SCIENTIFIC SESSIONS OTORHINOLARYNGOLOGY

The preliminary program for the Tuesday evening session on otorhinolaryngology comprises the following four subjects: **Suspension Laryngoscopy**, **"Effects of Streptomycin on Eighth Nerve Function"**, **Anatomical Considerations of the Temporal Bone**, and **Chronic Laryngeal Stenosis**.

The Wednesday evening program as stated under Ophthalmology will be on the subject **Neoplasms of the Orbit and Nasal Accessory Sinuses**, and will be a joint session with the ophthalmologists.

Four subjects have been selected for discussion at the Thursday evening meeting as follows: **Repair of the Facial Nerve**, **Surgical Considerations of the Physiology of the Nose**, **Tumors of the Nasopharynx**, and **The Role of Pregnancy in Otosclerosis**.

GENERAL SURGERY PANEL DISCUSSIONS

General surgery panel discussions will be held on Monday, Tuesday and Wednesday afternoons, from 1:30 to 3:00 and from 3:30 to 5:00 o'clock, and on Thursday afternoon from 3:30 to 5:00. The early session on Monday will be on **Acute Renal Failure in Surgical Patients**, with Dr Frederick A. Collier of Ann Arbor as moderator and the late session on **Tumors of the Mouth, Jaw and Face**, with Dr Gordon B New of Rochester Minnesota, as the moderator. The early session on Tuesday will be on **Low Lying Malignant Lesions of the Bowel**, with Dr Fred W Rankin of Lexington, Kentucky as moderator and the late session on **Evaluation of Liver Function in Relation to Surgery** with Dr Nathan A Womack Iowa City as moderator. The early session on Wednesday will be on **Peripheral Arterial Disease** with Dr Alton Ochsner of New Orleans as moderator and the late session on **Ulcerative Colitis** with Dr Henry W Cave of New York as moderator. The Thursday session will be on **Isotopes in Surgery** with Dr George M Curtis of Columbus as moderator.

OPHTHALMOLOGY PANEL DISCUSSIONS

Panel discussions in ophthalmology will be held Tuesday Wednesday and Thursday mornings from 9:00 to 10:30 o'clock. The Tuesday subject will be **Surgical Management of (1) Acute Inflammatory Glaucoma (2) Chronic Simple Glaucoma (3) Congenital Glaucoma**. The Wednesday subject will be **Congenital Cataract**. The Thursday subject will be **Surgery of the Oblique Muscles**.

OTORHINOLARYNGOLOGY PANEL DISCUSSIONS

Panel discussions in otorhinolaryngology will be held Tuesday Wednesday and Thursday mornings from 10:45 to 12:15 o'clock. The Tuesday subject will be **"Rehabilitation of the Hard of Hearing"** with Dr Walter P Work of San Francisco as moderator. The Wednesday subject will be **The Preparation of the Surgical Patient and Postoperative Care** with Dr Colby Hall of Los Angeles as moderator. The Thursday subject for discussion will be **Diseases of the Esophagus** with Dr Alden H Miller of Los Angeles as moderator.

SPECIALTY PANEL DISCUSSIONS

Specialty panel discussions will be held on Friday afternoon from 1:30 to 3:00 and from 3:15 to 4:45 o'clock, as follows:

Urology—Moderator Dr Reed M Nesbit, Ann Arbor

1 30 to 3:00 p.m.—“The Clinical Management of Branched Renal Calculi.”

3:15 to 4:45 p.m.—“Present Day Management of Urinary Tract Infections.”

Orthopedic Surgery—Moderator Dr John C. Wilson, Los Angeles

1 30 to 3:00 p.m.—“Mechanical Derangements of the Knee Joint.”

3 15 to 4:45 p.m.—“Fractures About the Hip.”

Thoracic Surgery—Moderator Dr Frank S. Dolley, Los Angeles

1 30 to 3:00 p.m.—“Diagnosis and Surgical Treatment by Pulmonary Resection for Carcinoma, Bronchiectasis, and Tuberculosis.”

3 15 to 4:45 p.m.—“Surgery of the Esophagus.”

Plastic Surgery—Moderator Dr Truman G. Blocker Jr, Galveston

1 30 to 3:00 p.m.—“Congenital Facial Deformities.”

3 15 to 4:45 p.m.—“Burn Contractures of the Extremities.”

Gynecology and Obstetrics—Moderator Dr John C. Burch, Nashville

1 30 to 3:00 p.m.—“Hysterectomy Physiological Considerations—Indications.”

3 15 to 4:45 p.m.—“Hysterectomy Technical Considerations—Complications.”

Neurological Surgery—Moderator Dr Howard C. Naffziger, San Francisco

1 30—“Cerebral Angiography.”

FORUM ON FUNDAMENTAL SURGICAL PROBLEMS

The Forum on Fundamental Surgical Problems, one of the most popular features of Clinical Congresses during the past few years, will be held on Tuesday through Friday mornings, in two sections meeting concurrently. Brief reports of original clinical and experimental observations relating to the broad aspects of surgery and the surgical specialties will be presented under the general direction of Dr Owen H. Wangensteen, chairman of the committee, Forum on Fundamental Surgical Problems.

HOSPITAL CONFERENCES

The opening meeting of the twenty-seventh Hospital Standardization Conference will constitute the first formal session of the Clinical Congress, and will be a General Assembly for both surgeons and hospital representatives. Dr Arthur W. Allen of Boston, President of the College, will preside. The hospital conferences will continue on Monday afternoon, with sessions following on

Tuesday, Wednesday and Thursday mornings, afternoons and evenings.

Hospital trustees, administrators, heads of the various hospital departments and their personnel nursing groups, and many other persons directly or indirectly concerned about hospital progress, are invited to participate in the discussions at the hospital conferences, at which leaders in the hospital field are the speakers and the moderators. The meetings will include formal sessions, panel discussions, round table conferences, symposia, and forums.

A meeting which is always of great interest to hospital administrators and members of medical staffs in hospitals, as well as to surgeons, is the symposium on graduate training in surgery which is scheduled for Thursday afternoon after the annual meeting of Fellows.

COMMITTEE ON ARRANGEMENTS

The Committee on Arrangements for the Clinical Congress in Los Angeles has been well organized and is actively functioning. The membership follows:

General Committee

Donald G. Tollefson, M.D. F.A.C.S., *Chairman*
Hugh T. Jones, M.D. F.A.C.S., *Vice-Chairman*
Harold Lincoln Thompson, M.D. F.A.C.S., *Secretary*
Treasurer
Gilbert J. Thomas, M.D. F.A.C.S., *Represent of the College*
E. Vincent Askey, M.D., F.A.C.S.
Max W. Bay, M.D. F.A.C.S.
J. MacKenzie Brown, M.D. F.A.C.S.
Lawrence Chaffin, M.D. F.A.C.S.
A. Ray Irvine, M.D. F.A.C.S.
Maurice Kahn, M.D. F.A.C.S.
W. E. MacIntosh, M.D.
B. O. Raulston, M.D.
Louis J. Regan, M.D.
Carl Roemer, M.D., F.A.C.S.
Stafford Warren, M.D.

Committee for the Southern California Chapter

Ray B. McCarty, M.D. F.A.C.S., *Riveride*
Meredith G. Beaver, M.D. F.A.C.S., *Redlands*
Clarence E. Rees, M.D. F.A.C.S., *San Diego*
Carl G. Johnson, M.D. F.A.C.S., *Long Beach*
James H. Saint, M.D. F.A.C.S., *Santa Barbara*

Hospital Committee

The members of the hospital committee are listed with the list of hospitals participating in the clinical program which precedes the preliminary schedule of hospital clinics later in this article.

MEDICAL MOTION PICTURES

An appreciated feature of the Clinical Congress will again be the showing of medical motion pictures each day. The latest available pictures on

surgery and related subjects will be presented. Special showings will be arranged of medical motion pictures in the fields of ophthalmology and otorhinolaryngology. Both sound and silent films will be shown all of which will have been approved by the Committee on Motion Pictures. Some of the newer medical motion pictures now under production will be shown.

TECHNICAL AND SCIENTIFIC EXHIBITION

The Technical and Scientific Exhibits will occupy the Ballroom foyer, the Renaissance Room and the Galleria of the Biltmore Hotel, according to present plans. Leading manufacturers of surgical instruments, x ray apparatus, sterilizers, operating room lights, ligatures, dressings, hospital apparatus and supplies of all kinds, and pharmaceuticals, and publishers of medical books will be represented.

ADVANCE REGISTRATION

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 Harold Lincoln Thompson, M.D. F.A.C.S., *Secretary-Treasurer*
 Gilbert J. Thomas, M.D. F.A.C.S., *Representative of the College*
 E. Vincent Askey, M.D. F.A.C.S.
 Max W. Ray, M.D. F.A.C.S.
 J. MacKendie Brown, M.D. F.A.C.S.
 Lawrence Chaffin, M.D., F.A.C.S.
 A. Ray Irvine, M.D. F.A.C.S.
 Maurice Kahn, M.D. F.A.C.S.
 W. E. MacPherson, M.D.
 R. O. Raulston, M.D.
 Locke J. Regan, M.D.
 Carl Kneche, M.D., F.A.C.S.
 Stafford Warren, M.D.

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PRELIMINARY CLINICAL PROGRAM

PARTICIPATING HOSPITALS AND HOSPITAL CLINICS COMMITTEE

California Hospital, Los Angeles—William F. Quinn, M.D.
 Cedars of Lebanon Hospital, Los Angeles—Adolph A. Kutzmann, M.D. F.A.C.S.
 Children's Hospital, Los Angeles—J. Norton Nichols, M.D., F.A.C.S.
 French Hospital, Los Angeles—Pierre Paul Viole, M.D.
 Glendale Sanitarium and Hospital, Glendale—Eugene J. Joergenson M.D. F.A.C.S.
 Hospital of the Good Samaritan, Los Angeles—Francis M. McKeever M.D.
 Collis P. and Howard Huntington Memorial Hospital, Pasadena—Leroy B. Sherry M.D. F.A.C.S.
 Los Angeles County Hospital Los Angeles—Clarence J. Berne, M.D. F.A.C.S.
 Methodist Hospital of Southern California, Los Angeles—Paul A. Quaintance, M.D. F.A.C.S.
 Orthopaedic Hospital, Los Angeles—Ward M. Rolland, M.D. F.A.C.S.
 Physicians and Surgeon Hospital, Glendale—John R. Paxton, M.D. F.A.C.S.
 Presbyterian Hospital—Olmsted Memorial, Hollywood—William H. Snyder M.D. F.A.C.S.
 Queen of Angels Hospital, Los Angeles—Donald E. Ross, M.D. F.A.C.S.

St. Francis Hospital, Lynwood—Floris G. Cooper M.D. F.A.C.S.
 St. John's Hospital, Santa Monica—George Arnold Stevens, M.D. F.A.C.S.
 St. Joseph Hospital, Burbank—Ralph H. Walker M.D. F.A.C.S.
 St. Luke Hospital, Pasadena—James M. Marshall, M.D. F.A.C.S.
 St. Vincent's Hospital, Los Angeles—William P. Kroger, M.D., F.A.C.S.
 Santa Fe Coast Lines Hospital, Los Angeles—Richard J. Flamm, M.D. F.A.C.S.
 Santa Monica Hospital, Santa Monica—Leo J. Madsen M.D. F.A.C.S.
 U.S. Army McCracken General Hospital, Pasadena—Colonel Lawrence C. Ball, M.C., U.S.A.
 U.S. Naval Hospital, Long Beach—Captain F. C. Hill
 U.S. Veterans Administration, Birmingham General Hospital, Van Nuys—Joseph A. Weinberg, M.D.
 U.S. Veterans Administration, Wadsworth General Hospital, Sawtelle—Francis A. Byron, M.D.
 White Memorial Hospital, Los Angeles—Clarence E. Stafford, M.D. F.A.C.S.

CLINICS IN LOS ANGELES AND VICINITY HOSPITALS

CALIFORNIA HOSPITAL, LOS ANGELES

Tuesday

8:00-12:00. *General Surgery Operative Clinic*: Gastrointestinal Surgery Vagotomy and Gastroenterostomy JACK FARRIS and ASSOCIATES.
 8:00-1:00. *General Surgery Operative Clinic*: Gastric Resections. WILLIAM F. QUINN NORMAN CARDEY
 8:00-1:00. *Genitourinary Surgery Operative Clinic*: Two-term Abdominopelvic Resection MALCOLM HILL and ASSOCIATES.

Wednesday

8:00-1:00. *Tumor Surgery Operative Clinic*: Carcinomas of Face, Neck, and Breast. LOS ANGELES TUMOR INSTITUTE STAFF
 8:00-1:00. *Thoracic Surgery Operative Clinic*: Carcinoma of Lung. LYMAN BREWER and ASSOCIATES.
 8:00-1:00. *Tumor Surgery Operative Clinic*: Carcinoma of Stomach. L. A. ALLENOR

Thursday

General Surgery Operative Clinic: Lesions of Thyroid. O. DALE LLOYD
General Surgery Operative Clinic: Cholecystic Disease. W. H. OLDS and ASSOCIATES.
General Surgery Operative Clinic: Hernioplasty. F. LIEB, A. LAUBERBERGER.

Friday

Gynecology Operative Clinic: Total Hysterectomy. D. TOLLERSON and ASSOCIATES.
 8:00-1:00. *Gynecology Operative Clinic*: Vaginal Hysterectomy. PAULA HORN and ASSOCIATES.

8:00-1:00. *Gynecology Operative Clinic*: Total Hysterectomy. WILLIAM BROWNFELD and ASSOCIATES.
 8:00-1:00. *Gynecology Operative Clinic*: Low Cervical Section and other Gynecological Procedures. RALPH THOMPSON, GEORGE HEWITT A. N. WEBB.

CEDARS OF LEBANON HOSPITAL, LOS ANGELES

Tuesday

1:00-2:00. *General Surgery Operative Clinic*: Thyroidectomy. M. KAHN AL. BAY
 6:00-1:00. *Gynecology Operative Clinic*: Selected cases. E. KRAMERLICH.
 6:00-1:00. *Genitourinary Surgery Operative Clinic*: Selected cases. J. STEINBERG.

Wednesday

1:00-2:00. *General Surgery Operative Clinic*: Smithwick operation. M. KAHN AL.
 2:00-3:00. *Neurosurgery*. Operative Clinic: Selected cases. TRACY PUTNAM.

Thursday

1:00-2:00. *General Surgery Operative Clinic*: Abdominal surgery. I. J. OLCH.
 1:00-2:00. *Gynecology Operative Clinic*: Selected cases. JOSEPH HARRIS, LEON KROEM.
 1:00-2:00. *Genitourinary Surgery Operative Clinic*: Selected cases. J. STEINBERG.

Friday

1:00-2:00. *General Surgery Operative Clinic*: Selected cases. S. HERRINGSTON
 1:00-2:00. *Chest Surgery Operative Clinic*: Selected cases. A. GOLDMAN

Tuesday through Friday

10:00-12:00. *General Surgery* Nonoperative Clinics
Smithwick Operation Colectomy Gall Bladder Thyroid Roentgenology Pathology M. RABWIN D. ROSENBLUM, MAX BAY I. Y. OLCH Members of Thyroid Committee, EUGENE FREEDMAN N. FRIEDMAN.

FRENCH HOSPITAL, LOS ANGELES

Wednesday

10:30-11:50. *Tumor Surgery* Nonoperative Clinic Radial Cancer Surgery of Head and Neck—slides—cases. SAM PERLIN.
10:50-11:10. *Tumor Surgery* Nonoperative Clinic Combined Attack of Cancer of Head and Neck—slides—cases. CLYDE EMERY.
11:10-11:30. *Tumor Surgery* Nonoperative Clinic Benign Tumors of Neck—slides. ALONIS POLLAK.
11:30-11:50. *General Surgery* Nonoperative Clinic Removal of Thyroglossal Duct Cyst—motion pictures. ELMER BALL.

Wednesday Afternoon

Round Table Discussion ARTHUR J. MENDENHALL, FRED GASPARD IVO LOPIZICH VICTOR CEVALU PIERRE VIOLE.

HOSPITAL OF THE GOOD SAMARITAN
LOS ANGELES

Tuesday

8:00-12:00. *General Surgery* Operative Clinic Selected Cases. LAWRENCE CHAFFIN WILLIAM NORRIS.
8:00-12:00. *Thoracic Surgery* Operative Clinic Selected Cases. JOHN C. JONES.
8:00-12:00. *Neurosurgery* Operative Clinic Selected Cases. GEORGE PATTERSON.

Wednesday

8:00-12:00. *General Surgery* Operative Clinic Selected Cases. PHILIP J. CONYANT.
8:00-12:00. *Genitourinary Surgery* Operative Clinic Selected Cases. KENNETH SMILEY.
8:00-12:00. *Neurosurgery* Operative Clinic Selected Cases. CARL W. RABD.
9:00-12:00. *Ophthalmology* Operative Clinic Selected Cases. GEORGE P. LANDECKER.

Thursday

8:00-12:00. *General Surgery* Operative Clinic Selected Cases. C. J. HERN, J. N. NICHOLS, KENNETH BLAKE.
8:00-12:00. *Thoracic Surgery* Operative Clinic Selected Cases. FRANK S. DOLLEY.
Otorhinolaryngology Operative Clinic Selected Cases. P. SHUMAKER.

Friday

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8:00-12:00. *Genitourinary Surgery* Operative Clinic Selected Cases. W. KLOER.
8:00-12:00. *Gynecology* Operative Clinic Selected Cases. H. SHAW.
8:00-12:00. *Orthopedic Surgery* Operative Clinic. Selected Cases. JOHN WILSON.

COLLIS P. AND HOWARD HUNTINGTON
MEMORIAL HOSPITAL, PASADENA

General Surgery Nonoperative Clinics Splenectomy, Indications and Results Surgical Treatment of Portal Hypertension Hernias in Children Problems of Early Ambulation

LOS ANGELES COUNTY GENERAL HOSPITAL,
LOS ANGELES

Tuesday through Friday

General Surgery Operative Clinic Selected Cases.
Ophthalmology Operative Clinic Selected Cases.
Otorhinolaryngology Operative Clinic Selected Cases.

METHODIST HOSPITAL OF SOUTHERN
CALIFORNIA, LOS ANGELES

Days not yet decided

8:00-12:00. *Thoracic Surgery* Operative Clinic Selected Cases. LYMAN A. BREWER, FRANK S. DOLLEY.
8:00-12:00. *Tumor Surgery* Operative Clinic Selected Cases. CLYDE EMERY TUMOR GROUP SAMUEL L. PERLIN.
8:00-12:00. *Orthopedic Surgery* Operative Clinic Selected Cases. HAROLD E. CROWE, KENNETH TOWNSEND.
8:00-12:00. *Ophthalmology and Otolaryngology* Operative Clinic Selected Cases. WALTER R. CRANE.
8:00-12:00. *Genitourinary Surgery* Operative Clinic Selected Cases. F. A. BENNETT, CARL L. MULLINGER.
8:00-12:00. *Gynecology* Operative Clinic. Selected Cases. A. A. BLATHERWICK CARL E. KNUDSEN ELDON W. TICE.
8:00-12:00. *Hand Surgery* Operative Clinic Selected Cases. JOSEPH H. BOYER.
8:00-12:00. *General Surgery* Operative Clinic Selected Cases. CLIFFORD O. BISHOP, G. R. DUNLEVY LEWIS F. ELLMORE, ADOLPH M. HANSEN E. A. NELSON ROY E. SHIPLEY JOSEPH A. PARKER HAROLD P. TOTTER.

ORTHOPAEDIC HOSPITAL, LOS ANGELES

Monday

8:00-12:00. *Orthopedic Surgery* Operative Clinic Spinal Fusion for Scoliosis. JOSEPH RUSSEN.

Wednesday

8:00-10:00. *Orthopedic Surgery* Operative Clinic Fascial Transplants. CHARLES LOWMAN.

Every Afternoon

Orthopedic Surgery Nonoperative Clinic.

Thursday Morning

10:00-12:00. *Orthopedic Surgery* Nonoperative Clinic: Surgical Conference. HAROLD CROWE.

PHYSICIANS AND SURGEONS HOSPITAL,
GLENDALE

Days not yet decided

8:30-12:00. *Gynecology* Operative Clinic: Vaginal Plastic Procedures. H. K. MARSHALL.

- 8 30- 00. *General Surgery* Operative Clinic: Two-Team Abdominoperineal Resection of Rectum. R. E. BEET.
- 8 30- 100. *General Surgery* Operative Clinic: Resection Carcinoma of Esophagus or Transthoracic Vagotomy. H. L. THOMPSON.
- Orthopaedic Surgery* Nonoperative Clinic: Knee Surgery. HUGH JONES.
- Orthopaedic Surgery* Nonoperative Clinic: Surgical Treatment of Fractures—motion pictures. CHARLES GILLILLAM.
- Orthopaedic Surgery* Nonoperative Clinic: Internal Fixation of Fractures. JOSEPH WOLF.
- Orthopaedic Surgery* Nonoperative Clinic: Backache. JOHN BLACK.
- Gynecology* Nonoperative Clinic: General V. ginal Prolapse. H. E. MARSHALL, DAWSON TARR, MATT STUBBEVANT.

PRESBYTERIAN HOSPITAL-OLMSTED
MEMORIAL, HOLLYWOOD

Tuesday

- 8 00-9 00. *Tumor Surgery* Operative Clinic: Carcinoma of Breast. Tumor Board.
- 9 00- 00. *Tumor Surgery* Operative Clinic: Carcinoma of Cervix. Tumor Board.
- 00- 00. *Tumor Surgery* Nonoperative Clinic: Tumor Clinic. Tumor Board.

Wednesday

- 8 00- 00. *Genitourinary Surgery* Operative Clinic: Retropubic. CARL RUTCHIE.
- 9 00- 00. *Thoracic Surgery* Operative Clinic: Lobectomy. BEAT CORRIE.
- 00- 00. *General Surgery* Operative Clinic: Gastric Resection. WILLIAM SUTTER.
- 00- 00. *Genitourinary Surgery* Nonoperative Clinic: Surgical Treatment for Genital Rehabilitation Including Urinary Incontinence. ARNOLD KRIEGL.
- 00- 1 00. *Traumatic Surgery* Nonoperative Clinic: Traumatic Injuries to Abdomen. DONALD COLLINS.

Thursday

- 8 00-9 00. *General Surgery* Operative Clinic: Thyroidectomy. BUELL SPRAGUE.
- 9 00- 00. *Plastic Surgery* Operative Clinic: Mastopexy. OTTO BAKER.
- 0 00- 1 00. *Plastic Surgery* Nonoperative Clinic: Demonstration Plastic Technique. OTTO BAKER.

QUEEN OF ANGELS HOSPITAL, LOS ANGELES

Days not yet decided

- Gynecology* Operative Clinic: Selected cases.
- Gynecology* Nonoperative Clinic: Low Spinal Anesthesia in Obstetrics—A Review of 2,000 Cases, Low Dose Irradiation in Sterility Due to Asovulation, Multiple Blood Transfusions in the Treatment of Severe Postpartum Hemorrhage; The Conservative Management of Endometriosis in Patients of Child-bearing Age; Rupture of the Uterus at Term Before the Onset of Labor—Case Report, An Unusual Congenital Anomaly of the Uterus Complicated by Pyometra; Adenocarcinoma of the Uterus—A Ten-year Survey.
- Otolaryngology* Operative Clinic: Fenestration. HOWARD P. HOOVER.

Ophthalmology Operative Clinic: Cataract and others.

Otolaryngology Nonoperative Clinic: Exhibit and Symposia—Fenestration. HOWARD P. HOOVER.

Otolaryngology Nonoperative Clinic: Acute Infections of the Throat. ARTHUR W. MILLER.

Ophthalmology Nonoperative Clinic: Opacities of the Cornea Treated by Radium—Illustrated. WILLIAM H. BOWD.

ST JOHN'S HOSPITAL, SANTA MONICA

Monday through Friday

General Surgery Operative Clinic: Selected cases. MARSH H. RABBIT, JOHN ROBERTS, LOUIS SPERLING, G. ARNOLD STEVEN, DR. NEAL.

Genitourinary Surgery Operative Clinic: Selected cases. GILBERT J. THOMAS, FRED C. SCULLEN, BECKER.

Gynecological Surgery Operative Clinic: Selected cases. BLAKE WATSON, JAMES C. DOYLE.

Orthopaedic Surgery Operative Clinic: Selected cases. DANIEL H. LEVANTHAL.

ST JOSEPH HOSPITAL, BURBANK

Days not yet decided

General Surgery Operative Clinic: Selected cases.

ST LUKE HOSPITAL, PASADENA

Day not yet decided

Orthopaedic Surgery Nonoperative Clinic.

Genitourinary Surgery Nonoperative Clinic.

ST VINCENT'S HOSPITAL, LOS ANGELES

Tuesday

- 9 00- 00. *Otolaryngology* Operative Clinic: Selected cases. J. MACKENNIE BROWN.
- 9 00- 100. *Ophthalmology* Operative Clinic: Selected cases. A. RAY LINTZ.
- 9 00- 00. *General Surgery* Operative Clinic: Thyroidectomy. W. M. P. KROGER.
- 9 00- 00. *General Surgery* Operative Clinic: Selected cases. FRANK J. BRESLIN.
- 9 00- 100. *General Surgery* Operative Clinic: Selected cases. F. E. BROWN, HENRY J. LAURE.
- 9 00- 00. *Tumor Surgery* Operative Clinic: Selected cases. IAN MACDONALD, LEWIS W. GIBBS.
- 10 00- 00. *Tumor Surgery* Nonoperative Clinic: Malignant Lesions of Colon. K. S. DAVIS.
- 1 30- 00. *General Surgery* Nonoperative Clinic: Surgery of Colon—motion pictures. W. H. D. VIEL.
- 1 00- 00. *General Surgery* Nonoperative Clinic: Surgery of Esophagus—motion picture. H. LINDGREN THOMPSON.
- 100- 00. *General Surgery* Operative Clinic: Selected cases. CONRAD J. B. UNDAERD.
- 00- 1 00. *General Surgery* Operative Clinic: Colon Surgery. RALPH V. BRIDGE.

Wednesday

- 9 00- 1 00. *Orthopaedic Surgery* Operative Clinic: Selected cases. HUGH T. JONES, JOHN R. BLACK.
- 9 00- 1 00. *Orthopaedic Surgery* Operative Clinic: Selected cases. FRANCIS M. MCKINNEY.
- 9 00- 1 00. *Neurosurgery* Operative Clinic: Selected cases. RUTHER B. RAMEY.

- 9:00-12:00. *Neurosurgery* Operative Clinic Selected cases. C. HUNTER SHERIDEN
- 9:00-12:00. *Otolaryngology* Operative Clinic Fenestration. HOWARD P. HUBER
- 9:00-12:00. *Ophthalmology* Operative Clinic Selected cases. JOHN P. LORIAN
- 9:00-12:00. *Plastic Surgery* Operative Clinic Selected cases. ARTHUR E. SMITH
- 10:00. *Tumor Surgery* Nonoperative Clinic Thyroid Malignancy. HENRY J. LANGE
- 10:30. *Tumor Surgery* Nonoperative Clinic Struma Lymphomatosa and Fibrosis. ROBERT C. SURREIDGE
- 11:00. *General Surgery* Nonoperative Clinic Obstructing Corrosive Gastritis. LOUIS C. BENNETT

Thursday

- 9:00-11:00. *General Surgery* Operative Clinic Selected cases. E. VINCENT ASKEY
- 9:00. *Otolaryngology* Operative Clinic Selected cases. JOSEPH B. STEVENS
- 9:00-12:00. *Gynecology* Operative Clinic Selected cases. BERNARD J. HANLEY JOHN C. McDERMOTT
- 9:00-12:00. *Proctology* Operative Clinic Surgery of Colon. WILLIAM H. DANIEL
- 9:00-12:00. *General Surgery* Operative Clinic Vagus Neurectomy. EDWARD C. PALLETTE
- 9:00-12:00. *Ophthalmology* Operative Clinic Selected cases. CLARENCE H. ALBAUGH
- 10:00. *Orthopedic Surgery* Nonoperative Clinic Surgery of Hand. FRANK J. BRESLIN
- 10:30. *Orthopedic Surgery* Nonoperative Clinic Surgery of Knee Joint. HUGH T. JONES JOHN R. BLACK
- 11:00. *Neurosurgery* Nonoperative Clinic Surgical Management of Intracranial Aneurysms—motion picture and lantern slide illustrations. ROBERT B. RANNEY and AIDAN A. RANNEY
- 11:00-12:00. *General Surgery* Operative Clinic Selected cases. E. ERIC LARSON

Friday

- 9:00-11:00. *General Surgery* Operative Clinic Selected cases. LOUIS C. BENNETT
- 9:00-11:00. *Plastic Surgery* Operative Clinic Selected cases. ARTHUR E. SMITH
- 9:00-12:00. *General Surgery* Operative Clinic Selected cases. FRANCIS E. BROWN HENRY J. LANGE
- 9:00-12:00. *General Surgery* Operative Clinic Selected cases. WM. P. KROGER, ROBERT C. SURREIDGE
- 9:00-12:00. *Genitourinary Surgery* Operative Clinic Selected cases. A. J. SCHOLL, E. CROWLEY
- 10:00. *General Surgery* Nonoperative Clinic Thoracic Vagus Neurectomy—motion picture. EDWARD C. PALLETTE
- 10:30. *General Surgery* Nonoperative Clinic Surgery of Spleen. RALPH V. BYRNE
- 11:00. *General Surgery* Nonoperative Clinic Carcinoma of Tongue, or Primary Mandibular Tumors. IAN MACDONALD, LEWIS GIBBS
- 11:00-12:00. *General Surgery* Operative Clinic Selected cases. DAVID A. SCHMIDT

SANTA FE COAST LINES HOSPITAL,
LOS ANGELES

Day not yet decided

- 9:00-11:00. *Genitourinary Surgery* Operative Clinic Retropubic Prostatectomy. V. J. GALLAGHER
- 9:00-10:00. *Neurosurgery* Nonoperative Clinic The Herniated Intervertebral Disc. HENRY M. CHASE

- 9:00-10:00. *Otolaryngology* Nonoperative Clinic Allergy of the Nose and Paranasal Sinuses. GORDON J. MCCURDY

SANTA MONICA HOSPITAL, SANTA MONICA

Day not yet decided

- 9:00-11:00. *Traumatic Surgery* Nonoperative Clinic Case Presentations in an Active Traumatic Service. C. A. LINDBLUM (Veterans Administration)

U.S. ARMY MCCORRACK GENERAL HOSPITAL,
PASADENA

Day not yet decided

- 9:00-9:30. *Plastic Surgery* Nonoperative Clinic Reconstruction of the face. MONROE RUCH
- 9:30-10:00. *Orthopedic Surgery* Nonoperative Clinic Treatment of Hip Fractures. ROBERT KIMO
- 10:00-10:30. *Genitourinary Surgery* Nonoperative Clinic Antimicrobial Urinary Infections. LYMAN STEWART
- 10:30-10:45. *General Surgery* Nonoperative Clinic Repair of Inguinal Hernia. COLONEL LAWRENCE C. BALL
- 10:45-11:00. *General Surgery* Nonoperative Clinic Treatment of Pancreatic Cysts. GORDON K. SMITH
- 11:00-11:30. *General Surgery* Nonoperative Clinic Management of Gastric Surgery. COLONEL LAWRENCE C. BALL

U.S. NAVAL HOSPITAL, LONG BEACH

Tuesday or Wednesday

- 9:00-12:00. *General Surgery* Operative Clinic Gastric Surgery. Chief of Surgery
- 9:00-12:00. *Orthopedic Surgery* Operative Clinic Selected cases. Chief of Orthopedics
- 9:00-12:00. *Genitourinary Surgery* Operative Clinic Selected cases. Chief of Genitourinary
- 1:00-4:00. *General Surgery* Nonoperative Clinic Ward Rounds, Presentation of Cases, Ward B-3 Motion Pictures. Chief of Surgery
- 1:00-4:00. *Orthopedic Surgery* Nonoperative Clinic Ward Rounds, Presentation of Cases. Chief of Orthopedics and Civilian Consultants
- 1:00-4:00. *Genitourinary Surgery* Nonoperative Clinic Ward Rounds, Presentation of Cases. Chief of Genitourinary and Civilian Consultants
- 1:00-4:00. *Neurosurgery* Nonoperative Clinic. Ward Rounds, Presentation of Cases. Discussion of Herniated Discs. Neurosurgical Staff

U.S. VETERANS ADMINISTRATION
BIRMINGHAM GENERAL HOSPITAL,
VAN NUYS

Wednesday

- 9:00-11:00. *Thoracic Surgery* Operative Clinic Pulmonary Decortication. JOSEPH WEINBERG
- 9:00-11:00. *Genitourinary Surgery* Operative Clinic Repair of Penoscrotal Fistula Repair of Decubitus Ulcer. ERNEST BORA
- 9:00-11:00. *Genitourinary Surgery* Nonoperative Clinic Renal Plastic Surgery. DONALD MALCOLM
- 9:00-11:00. *Neurosurgery* Operative Clinic Medullary Tractotomy. JOHN FRENCH
- 9:00-11:00. *Otolaryngology* Operative Clinic: Correction of Nasal Obstruction. SAMUEL KAPLAN
- 9:00-11:00. *General Surgery* Operative Clinic Thoracolumbar Sympathectomy by Intercostal Approach. THOMAS B. MASSIELL

- 9:00-1:00 *General Surgery* Operative Clinic Transabdominal Vagotomy FRANKLIN WILKINS.
 9:00-11:00 *Orthopedic Surgery* Nonoperative Clinic Tuberculous bone and joint—Treatment with Streptomycin—Presentation of cases and discussion. JERRY H. ALDER and Staff.
 9:00-1:00 Nonoperative Clinic *Exhibit*—Phlebography in Peripheral Venous Disease. THOMPSON B. MASSELL.

U.S. VETERANS ADMINISTRATION
 WADSWORTH GENERAL HOSPITAL,
 LOS ANGELES (Sa tele)

Days not yet decided

- 9:00-9:30 *Ophthalmology* Nonoperative Clinic Fundus Lesions With Pathological Sections and Microphotographic Slides. A. RAY LIVING, C. S. MUNKA.
 9:00-1:00 *General Surgery* Operative Clinic Subtotal Gastric Resection and Subtotal Vagotomy G. ARVID STEVENS.
 9:00-1:00 *General Surgery* Nonoperative Clinic Symposium on Peripheral Vascular Disease Tetra-ethyl ammonium in the treatment of Peripheral Vascular Disease. Results of Histidine and Ascorbic Acid Treatment of Peripheral Vascular Disease. C. L. McKEITHEN, R. WILSON and M. T. RYAN.
 9:00-1:00 *Orthopedic Surgery* Nonoperative Clinic A New Method for the Movement of Fluid in the Extremities. F. G. LUTHER and J. P. SAMMON.
 9:00-1:00 *Orthopedic Surgery* Nonoperative Clinic Amputations in Peripheral Vascular Disease. ROBERT MAZZE.
 9:00-1:00 *Anesthesiology* Operative Clinic Lumbar Sympathectomy. CHARLES LUTHER.
 9:00-1:00 *Gynecology* Operative Clinic Nonoperative Clinic Symposium on the Diagnosis and Early Radical Treatment of Carcinoma of the Bladder. GILBERT J. THOMAS, IRVING C. SCHULZBERGER.

- McCLEERY GLAZIER, JOHN B. HIRSHADKA, BERNARD B. SILVER, HARRY A. ZIM.
 9:00-1:00 *Anesthesiology* Operative Clinic Pain Clinic. C. F. McCLEERY, ERNEST WARMOCK, NATHAN RUFF.
 9:30-1:00 *Otolaryngology* Nonoperative Clinic: Malignancies of Ear, Nose and Throat with Case Presentations. C. S. MUNKA and Staff.
 1:00-3:00 *Otolaryngology* Nonoperative Clinic: Concentration Operation for Otitis Media with Case Presentations. C. S. MUNKA and Staff.
 10:30-11:00 *Neurosurgery* Nonoperative Clinic: Anterior Transplantation of the Spinal Cord, Operative Indications and Technique. M. HENNER BROWN (Santa Monica Hospital).
 1:00-1:30 *Gynecology* Nonoperative Clinic: Ectopic Pregnancy and Endometriosis. B. H. SMITH (Santa Monica Hospital).

WHITE MEMORIAL HOSPITAL, LOS ANGELES

Tuesday

- Genitourinary Surgery* Operative Clinic: Selected cases. ROGER W. BARNES.
Genitourinary Surgery Nonoperative Clinic: Selected cases.

Wednesday

- Orthopedic Surgery* Operative Clinic: Selected cases. G. MORRIS TAYLOR.
Orthopedic Surgery Nonoperative Clinic: Selected cases.

Thursday

- Proctology* Operative Clinic: Selected cases. MALCOLM R. FILL.
Proctology Nonoperative Clinic: Selected cases.

AMERICAN COLLEGE OF SURGEONS APPROVES USE OF NURSE ANESTHETISTS

THE Board of Regents of the American College of Surgeons, at a meeting on February 22, 1948, adopted a resolution commending the services of nurses who have had special training in the administration of anesthesia and recommending the continuance of training courses in this field for nurses. The resolution reads as follows:

The American College of Surgeons regards with deep concern the actions of some physician anesthesiologists in giving the impression to the laity in the public press that it is unsafe for experienced nurse anesthetists to conduct surgical anesthesia. While it supports the increasing tendency of having physician anesthesiologists in charge of surgical anesthesia, it deplores at this time any propaganda for the elimination of the trained nurse anesthetist. On the contrary, the American College of Surgeons is of the opinion

that in view of the inadequacy in number of the physician anesthesiologists and in view of the splendid record of achievement of the nurse anesthetists, institutions engaged in the training of nurses for this purpose should be encouraged to continue their programs.

In its *Manual of Hospital Standardization* the American College of Surgeons states with respect to personnel in the Department of Anesthesia:

"The personnel in the Department of Anesthesia must consist of trained, competent assistants. Nurse anesthetists who have specialized in the administration of anesthetics are usually competent and acceptable for the work, but since they are not physicians licensed to administer drugs, they should be under medical supervision. If it is impossible to obtain or maintain a specially trained anesthetist in the community, a member of the medical staff, who has had experience in anesthesia, might assume the responsibility for supervision and direction of the department of anesthesia."

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FRANKLIN H. MARTIN, M.D.

Founder and Managing Editor 1905-1955

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INTERNATIONAL ABSTRACTS OF SURGERY

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COLLECTIVE REVIEW

THE INCIDENCE OF GASTRIC CANCER

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IN evaluating the incidence of gastric cancer a distinction must be made between the actual occurrence of the disease and the recorded morbidity. Many factors contribute to a disparity between the two particularly on a world wide level. Differences in diagnostic techniques, dissimilar statistical methods and inequalities in the status of public health education and medical care challenge the validity of both international comparisons of incidence rates and regional comparisons within a single country.

Cancer is not for the most part a reportable disease with the result that no all inclusive figures on its occurrence are available; the most reliable indices remain mortality records and institutional reports. Since death rates take no cognizance of cured or undiagnosed cases, they obviously understate the true incidence.

No other nation moreover issues classified data on the mortality from gastric cancer comparable to those in the United States Vital Statistics. In Western Europe information stems mainly from hospital reports and the compilations of individual physicians. The further one goes from the centers of western civilization the more haphazard statistical methods become in large areas of the world the sole sources of intelligence are isolated missionaries and physicians recording their observations without benefit of organizational facilities.

Until recently even in this country there was no statistical separation of cancer of the stomach; it was common practice to group it with malignant tumors of the liver, peritoneum and other gastrointestinal sites. Since virtually all intra-abdominal

and many extra-abdominal cancers metastasize to the liver this gave an ambiguous picture of the frequency of gastric carcinoma alone.

It is obvious that accurate incidence rates are impossible without correct diagnosis. For cancer of the stomach the standard antemortem procedure employs the barium meal followed by expert fluoroscopic and roentgenographic examination. Following the first gastrointestinal study by means of a barium-contrast meal in 1904 (47) the reported incidence of gastric cancer in the United States increased sharply until 1925. Then as diagnostic techniques became more standardized and statistical methods more precise the curve leveled out and even dropped slightly.

Similar clarification has yet to take place in those parts of the world where modern medical techniques have not yet penetrated or are unavailable to a large proportion of the population. Even in the United States there is a striking dissimilarity in the reported incidence for states enjoying a high level of medical care and those with inhabitants who are too poor, too ignorant or too neglected to obtain diagnosis and treatment of the symptoms referable to gastric carcinoma.

It is obviously impossible to draw definitive conclusions on the basis of present data. Nevertheless, such statistics as are available contribute to our knowledge of the incidence of the disease and can not be ignored.

SEX

Cancer of the stomach occurs more commonly in men than in women. In the United States, of the 26,135 persons who died of the disease in 1940 16,111 or 61.6 per cent, were males and 10,024 or 38.4 per cent, were females (58). They represented

From the Gastric Service of the Memorial Hospital, New York, New York.

TABLE I.—SEX DISTRIBUTION OF GASTRIC CANCER

Hospital and period	Total cases	Males		Females	
		Number	Per cent	Number	Per cent
Mayo Clinic, 1907-1933 (6)	2,399	1,560	78.7	1,374	57.9
Stat. of Nebraska, 1913-1917-18 (3)	153	673	33.7	380	46
College of Physicians and Surgeons, Baltimore, Md. (3)	1,000	583	58.3	417	41.7
University Hospital, Ann Arbor Mich.; Mayo Clinic, Rochester Minn.; and Northwestern Hospital, Chicago, 10 year period (30)	97	603	72	37	44.8
University Surgical Clinic, Bonn, 1894-1920 (40)	605	518	77.9	47	22
Department of Surgery Johns Hopkins University Baltimore (10)	547	70	10	38	3.8
Presbyterian Hospital, Chicago (14)	100	333	57	165	22
Fourth Medical and Surgical Division, Bellevue Hospital, New York, 30 year period (7)	441	338	70.6	103	23
Surgical Clinic, University of Leipzig, 1907-1913 (40)	468	120	45.6	106	24
University of Michigan Hospital, Ann Arbor Mich. 1907-1930 (10)	415	84.3		15	3.5
Carl F. Hartshorn Memorial Hospital, Boston and Poudre Hospital, Vernal, Mass. (10)	76	77		3	
Memorial Hospital, New York, 8-1915	1,200	8	68.3	73	51.3

21.4 per cent of the total cancer deaths among men and 12.1 per cent among women.

Great Britain exhibited a similar ratio of male preponderance (19). Of 13,402 fatalities from gastric carcinoma in England and Wales in 1940, 7,455 or 55.6 per cent, occurred in males and 5,947 or 44.4 per cent, in females. The stomach was the primary site of these cancers in 21.9 per cent of the men and in 16.1 per cent of the women.

Germany (16) revealed a like distribution, with 55.1 per cent of a total of 35,317 fatalities in men. In Australia (3) the percentage of male mortality was higher (61.3%).

The three-to-two ratio of male preponderance finds support in a series of 40,573 fatalities recorded by the Metropolitan Life Insurance Company over a 16 year period from 1917 to 1933 (9). This study showed a 30 to 50 per cent higher incidence rate among men. Moreover gastric neoplasms caused a total of twice as many cancer deaths among males as among females.

Many hospital reports throughout the world (Table I) reveal a greater difference in sexual inci-

dence, citing a two-to-one and even three-to-one ratio. The former figure finds corroboration at the Presbyterian Hospital, Chicago, and the Surgical Clinic of the University of Leipzig the latter at the Mayo Clinic, Rochester, Minnesota and Johns Hopkins Hospital, Baltimore. At the Memorial Hospital, New York, 68.6 per cent of the 1,100 cases studied from 1916 through 1946 occurred in males. A masculine incidence of 58.8 per cent at the College of Physicians and Surgeons, Baltimore, more closely approaches the proportion found in vital statistics.

AGE

Cancer of the stomach is primarily a disease of middle and late life, occurring most frequently between the fiftieth and seventieth years. Thus, in 1940 only 10.1 per cent of the deaths therefrom in the United States took place prior to the age of 50 in Great Britain and Wales 9.5 per cent in Germany 8.6 per cent and in Australia, 7.5 per cent. The Memorial Hospital series reveals a substantially larger proportion (27.1%) of patients under 51 years of age. The disparity may be due to the fact that vital statistics take cognizance only of fatalities.

This age factor is highly significant, predisposing to a greater incidence wherever life expectancy exceeds the fifth decade. In the United States, for example, with 20.4 per cent of the population over 50 years of age in 1940 (57) the death rate from gastric cancer was 10.8 per 100,000. Similar data for twenty representative states revealed, almost without exception, a high mortality in those with a large group of individuals over 50 years of age in contrast to a conspicuously lower rate in those where longevity was less (Table II).

These figures support less precise reports from other countries. In England and Wales, France, Germany, Norway, the Netherlands, and Australia, where a substantial proportion of the population lives for more than half a century, a high incidence of gastric cancer is reported. It is reputedly less common in such countries as the Union of Soviet Socialist Republics, Bulgaria, Rumania, and India, where fewer than 15.5 per cent of the population survive the fifth decade. Japan is an exception to this correlation between longevity and incidence with a relatively high mortality rate although only 15.3 per cent of its inhabitants reach the age of 50 (20). Nevertheless, it is safe to assert that if standardized statistics were available for the entire world, they would show a demonstrably higher incidence of gastric cancer wherever 20 per cent of the population or more attain the sixth decade of life.

Fatalities reach their highest level between the sixty-fifth and seventieth years. In 1940 16.7 per cent of all deaths from cancer of the stomach in the United States took place in this quinquennial period. In Germany the corresponding figure for the same age group was 19.7 per cent, and in England and Wales, 18.7 per cent. In all three countries the mortality peak occurred later for women than for men, i.e. between the seventieth and seventy-fifth years. This was the period of greatest fatality (19.7 per cent) for males as well as females in Australia, with the feminine crest persisting through the seventy-ninth year (Table III).

The high death rate after age 75 is noteworthy. In the United States 23.8 per cent of the total deaths from gastric carcinoma were in this advanced age group. In Germany, 19.3 per cent in England and Wales, 20.5 per cent, and in Australia, 25.8 per cent. There was a distinct preponderance of women in this category, due no doubt to their greater longevity.

However, the disease is by no means confined to the upper age brackets (Table III). In 1940 4.7 per cent of the deaths from cancer of the stomach in the United States took place in patients from 30 to 44 years old, 12.8 per cent in patients from 45 to 54 years old, and 24.8 per cent in patients from 55 to 64 years old. The corresponding figures for England and Wales were 4.6, 12.1, and 24.8 per cent; for Germany 4.4, 10.5, and 27.3 per cent; and for Australia 2.8, 11.0, and 23.2 per cent.

Even in the young, cancer of the stomach is not unknown. In 1940 the percentage of deaths in patients under 30 years of age was 0.6 in the United States, 0.4 in England and Wales, 0.3 in Germany, and 0.4 in Australia.

Clinical reports, based on morbidity rather than mortality, suggest a slightly higher incidence (17.34-39). Of 1,193 cases at the Memorial Hospital, 10 or 0.8 per cent occurred in pa-

TABLE II.—CRUDE DEATH RATE FROM GASTRIC CANCER AND POPULATION 50 YEARS AND OVER. UNITED STATES AND TWENTY SELECTED STATES 1940

State	Death rate per 100,000	Percent over 50 years	State	Death rate per 100,000	Percent over 50 years
United States	9.8	20.4	Michigan	21.6	0.8
Massachusetts	26.	3.0	Kansas	8.9	23.6
Vermont	3.	24.4	California	3.9	24.
New York	3.6	8.	Washington	8.	4.9
Pennsylvania	3.	20.0	Wyoming	8.	17.0
Ohio	4.	8.	Texas	1.5	6.6
West Virginia	14.9	16.	Georgia	9.9	5.
Illinois	24.	22.	Mississippi	0.	5.
Missouri	20.3	3.5	Alabama	9.7	4.9
North Dakota	5.8	9.	Louisiana	3.4	3.4
Minnesota	29.6	27.9			

United States, Sixteenth Census, 1940, Vital Statistics Rates in the United States, p. 407. Government Printing Office, Washington, D. C., 1942.

United States, Sixteenth Census, 1940, Population, Vol. II, Characteristics of Population, Table 26, p. 32. Government Printing Office, Washington, D. C., 1942.

tients under 31. At the Mayo Clinic (61) the ratio in this age group ranged from 0.8 to 1.4 per cent, and at the Presbyterian Hospital, Chicago, it was 1.2 per cent. Other institutional data (41, 12, 51) cite a morbidity for the first three decades of life of approximately 8 per cent in the total number of cases.

Gastric carcinoma is extremely rare in childhood. Between the fifteenth and thirtieth years, however, the incidence rises sharply in each successive 5 year period, with more than half of the cases occurring between the ages of 25 and 30. In 1942 501 proved cases of gastric cancer in patients under 31 years of age were collected from

TABLE III.—DEATHS FROM GASTRIC CANCER IN SELECTED AGE GROUPS

Country	Total cases	30-44 years		45-54 years		55-64 years		Greatest frequency	
		Number	Per cent	Number	Per cent	Number	Per cent	Period	Per cent
United States	26, 35	35	4.7	3,248	2.8	6,480	24.8	65-69 years	6.7
England and Wales	13,40	6	4.6	673	1.1	3,340	26.5	65-69 years	5.7
Australia	8, 6	31	8	900	3.2	43	3.2	70-74 years	0.7
Germany	22, 3.7	2, 14		2, 1.8	5	6, 618	27.3	65-70 years	0.7

United States, Sixteenth Census, 1940, Vital Statistics Rates in the United States, 1940 Table 1, p. 401. Government Printing Office, Washington, D. C., 1942.

England and Wales. The Registrar-General's Statistical Review of England and Wales, 1940. Part I, Medical, p. 116. (Annual Series 60, London, 1944.)

Australia, Commonwealth Bureau of Census and Statistics. Official Statistics of the Commonwealth of Australia. Bulletin 58, pp. 38 and Table 1. Deaths from Cancer, 1940. Canberra, 1941.

Germany, Statistik des Deutschen Reich. Band 247, Teil 32-35. Die Ursachen der Sterblichkeit im Deutschen Reich im Jahre 1938. Berlin, 1940.

TABLE IV — AGE DISTRIBUTION OF PATIENTS WITH GASTRIC CANCER

Memorial Hospital, New York, N. Y. 1916 through 1946

Age period	Total		Male		Female	
	Number	Per cent	Number	Per cent	Number	Per cent
Total	1,793	100	820	100	373	100
15-25 years	2				2	0.5
26-30 years	7	0.4			5	1.3
31-35 years	14	0.8				
36-40 years	48	2.7			6	1.6
41-45 years	8	0.4	31	3.8	34	9.1
46-50 years	33	1.8	3	0.4	40	10.7
51-55 years	190	10.6	11	1.3	80	21.4
56-60 years	80	4.5	30	3.7	54	14.5
61-65 years	30	1.7	33	4.0	77	20.6
66-70 years	60	3.3			7	1.9
71-75 years	60	3.3	28	3.4		
76-80 years	18	1.0			6	1.6
81-85 years						
86-90 years						

Total Males Females	Range	Average age
	15-85 years 30-86 years 17-79 years	57 years 57 years 55.9 years

the literature (34). In this group there was equal distribution between the sexes, which is in contrast to the predominance of males in the older age groups.

The incidence by age classes, in 1,193 cases of gastric neoplasms studied at the Memorial Hospital over a 30 year period does not correspond to that depicted in the United States and in other vital statistics (Table IV). In our cases the morbidity crest (19.3%) for both sexes occurred earlier from 61 through 65 years of age. The entire incidence prior to age 66 was greater with 13.2 per cent of the cases in patients from 31 through 45, 28.8 per cent from 46 through 55, and 36.3 per cent, from 56 through 65 years. The incidence of patients past 75 years was small, only 1.8 per cent.

Other institutions with large series of cases report similar findings. At the Mayo Clinic, the College of Physicians and Surgeons, and Johns Hopkins Hospital, the decade of greatest frequency was from 50 to 60 years of age (Table V). The later crest in the vital statistics is probably explained by the interval between recognition of the disease and death. If so, this gap may be expected to widen as diagnostic and surgical methods improve.

RACE

Comprehensive data on the racial incidence of gastric carcinoma are as yet unobtainable, due to paucity of diagnostic and statistical facilities in those areas of the world where the non white peoples are concentrated. Thus, information on negro susceptibility treats exclusively of the American negro; there are no reliable figures on his African brothers. The Semitic peoples are represented only by European and American Jews. It would be hazardous to attempt broad inferences from such limited material.

Negroes

In 1940 the negro death rate in the United States from cancer of the stomach was reported as 14.4 per 100,000 compared to 20.4 for the white population (58). The accuracy of this figure is open to doubt because of the geographical distribution of our colored population: large numbers live in rural areas of the South where medical facilities are sparse and a low level of education and income tends to prevent recourse to professional care except in extremis. Even in cities they lack easy access to well trained general practitioners.

Nevertheless, there are some factors which confirm the relative infrequency of gastric carcinoma among negroes. Because of a higher infant mortality rate and a greater incidence of tuberculosis and other chronic infectious diseases, the negro's life expectancy of 53.85 years in the United States is considerably less than the white man's of 64.97 years (59). In 1940 only 14.5 per cent of the colored population had passed the fifth decade, compared to 21.1 per cent of the white (57). Thus, negroes do not as often reach the ages at which gastric neoplasms are prone to occur.

Will the lesser incidence among negroes persist as their life span lengthens? In the 16 year series presented by Dublin in 1936, the most striking rise in the crude death rate from gastric cancer occurred in colored males from 9.6 per 100,000 in 1917 to 20.6 in 1933. During the decade from 1930 to 1940 the increase in life expectancy was twice as great for the negro population as for the white (6% for males and 11% for females) (6). While there is undoubtedly a correlation between this greater longevity and higher incidence, the improved educational status of the negro and better opportunities for medical care must also be considered as possible contributors to the rise in the recorded mortality from gastric cancer.

An interesting phenomenon is the earlier age at which the disease appears in negroes and reaches its peak. Of 200 patients about equally divided between negroes and whites (38) almost half in the colored group developed cancer between 30 and 50

PACK, McNEER INCIDENCE OF GASTRIC CANCER

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TABLE V—AGE DISTRIBUTION OF GASTRIC CANCER

Hospital and period	Total cases	Greatest frequency		Comment	
		Period	Per cent	Period	Per cent
Mayo Clinic, 1907-1938 (6)		30-60 years	33.5	Under 30 years	8
College of Physicians and Surgeons Baltimore Md. (3)	3,000	30-60 years	30.5	Under 30 years	4
University Hospital, Ann Arbor Mich. Mayo Clinic, Rochester Minn. and Angostura Hospital, Chicago, year period (50)	9	30-50 years	40.9	Between 30 and 60 years	8.5
University Surgical Clinic, Bonn, 1896-1930 (49)	665	5-60 years	30	patient under 30 years patient over 60 years	
Department of Surgery Johns Hopkins University Baltimore (34)	54	44-60 years	76	Under 30 years	5
Presbyterian Hospital Chicago (14)	300	60-69 years	34	Over 70 years	5
Fourth Medical and Surgical Division, Bellevue Hospital, New York, 30 year period ()	445	5-60 years	34.0	Under 30 years	7
University of Michigan Hospital Ann Arbor Mich. 1930-1939 (46)	4.5	5-60 years	30	Over 70 years	0
Callie P. Huntington Memorial Hospital, Boston and Foodville Hospitals, Wrentham, Mass. 1922-1933 (40)	213	30-60 years	33.3	Under 30 years	0
Memorial Hospital, New York, 1916-1940	4.03	35-65 years	36.3	Over 60 years	33.3
				Under 35 years	8
				Over 70 years	7.5

years of age while little more than a quarter of the white group developed this condition during those decades. In the Metropolitan Life Insurance Company series the average annual negro death rate for cancer of the stomach exceeded the white in the age group from 25 to 44 years. This is corroborated by United States Vital Statistics for 1940. Whereas only 9.0 per cent of the mortality among whites occurred prior to age 50 the analogous figure for the colored population was 23.4 per cent (Table VI). One and one half per cent of the negro deaths occurred before the fourth decade compared to 0.4 per cent of the white. From 30 to 44 years, the respective percentages were 11.6 and 4.2 from 45 to 54, 25.0 and 11.9.

The peak of negro incidence also occurs at an earlier age. In 1940 16 per cent of the fatalities from cancer of the stomach among the colored population occurred between the ages of 60 and 64. For the population as a whole the 5 year period of maximum mortality (16.7%) was that from 65 to 69 years while the peak for whites alone (17.1%) lay between that from 70 to 74.

While Jews are not strictly speaking a race there are many factors which lend interest to the incidence of gastric carcinoma among them. One is their reputed susceptibility to the disease, often

attributed to their predilection for highly seasoned foods. Theoretically their adherence to prescribed customs for thousands of years, the segregation imposed upon them and their tendency to marry among their own people might have precluded racial tendencies.

Statistical studies for several European cities with a large Jewish population fail to demonstrate a greater incidence of cancer of the stomach among Jews (43). If anything the disease was shown to be slightly more prevalent among non Jews in Budapest, Amsterdam, and Berlin.

TABLE VI.—DEATHS FROM GASTRIC CANCER, WHITE AND NEGRO POPULATION UNITED STATES 1940

Age period	White		Negro	
	No.	Percent	No.	Percent
Total	24, 6	00	1, 248	00
30-44 years	1, 004	4	4	11.6
45-54 years	87	9	66	5
55-64 years	1, 015	4.1	513	8.0
Period of greatest frequency	70-74 years	7	60-64 years	6

In the first named (53) the incidence among the Jews from 1924 to 1927 was 35.6 per 100,000 as compared to 37.5 for non-Jews. A more significant deviation appeared in comparisons of the estimated populations of cancer age on this basis the rates were 105.3 per 100,000 for Jews and 140.3 for non-Jews.

Similar studies in Amsterdam for from 1922 to 1926 also revealed a greater frequency of gastric neoplasms among non-Jews, 47.8 per 100,000 as compared to 27.9 for Jews. From 1920 to 1929 the mortality among Hebrews was 34.8 per 100,000 for males and 31.2 per 100,000 for females, compared to a rate of 50.8 per 100,000 for males and 35.4 per 100,000 for females for the population as a whole (23).

Although comparable statistics are not available for Berlin, it may be of interest to note that in that city from 1932 to 1934, carcinoma of the stomach and duodenum caused 24.18 per cent of the total cancer deaths among Jewish men and 16 per cent among Jewish women (62). The corresponding percentages for the entire population were 35.88 for males and 24.78 for females.

At the Memorial Hospital, with an exception among the large Hebrew population to draw upon there were 531 Jews (44.3%) in our series of 1,200 cases of gastric neoplasm.

It is possible that an exaggerated impression of Jewish susceptibility to gastric carcinoma is created by their concentration in large cities with extensive institutional facilities. Certainly their interest in medical care and insistence on the best available services would tend towards a high percentage of diagnoses among them. Nevertheless actual figures show a slightly greater prevalence among non-Jews.

Primitive races

In a few selected regions of the East where institutional statistics are available the Chinese exhibit a relatively high morbidity from gastric cancer. In East Sumatra for example where Javanese and Chinese coolies live under similar conditions, the stomach was the site of only 1 per cent of all carcinomas among the Javanese in contrast to 19 per cent among the Chinese (53). Liver cancer on the other hand, constituted 55 per cent of all malignant tumors among the Javanese, compared to 28 per cent among the Chinese. In connection with these figures, it may be significant that gastric ulcer rare among the Javanese is common among the Chinese.

Similar observations were made in Java (5) Among the Malaysians of Batavia, cancer of the stomach did not figure among the common forms of carcinoma but malignant tumors of the liver

were frequent. The Chinese population, on the other hand displayed approximately the same ratio between the stomach and other sites as was found in the Western Hemisphere (29).

The higher incidence among the Chinese was evident also in a series of 654 specimens of cancer examined and tabulated by the Institute for Medical Research in British Malaya (22). Whereas cancer of the stomach constituted only 3.5 per cent of the total number of cases, it represented 5.3 per cent of the cases among the Chinese. The low rate for East Indians in this city (1.7%) corroborated other observations on the infrequency of the disease in South India and Ceylon, due perhaps to the short life expectancy there.

The comparatively high incidence among the Chinese is matched in Japan. This may reflect the greater literacy and better facilities for medical care in that country.

Turning to the North American continent, it may be worth recording Bishop Rowe's observation that he never saw a case of cancer of the stomach in his many years of missionary work among the Eskimos (48). Against this favorable observation must be placed the early age at which these people succumb to pulmonary tuberculosis.

DIET

On the basis of present knowledge diet offers few clues to the incidence of gastric cancer. Although the disease has been attributed to the consumption of hot, spicy foods, it is relatively infrequent in Mexico where hot tamales and chili are dietary staples. It is virtually unknown among the fish-eating Eskimos but common in Japan where also fish is an important part of the diet. On the other hand, the Japanese use large quantities of spices and partly decayed plant products (21).

In India, where cancer of the stomach is rare it occurs most often among the meat-eating Christians (24). It is considered one of the common types of carcinoma in Persia, where meat-eating is usual. In contrast to its alleged rarity among peoples given to a bland vegetarian diet.

There is a high incidence among Scandinavians. Germans, Hollanders and Jews all of whom are notorious overeaters, in contrast to a relatively low rate among the Russians who have been on short rations for the past 30 years. In sections of Germany (56) Austria (56) and Russia (43, 45) there was a definite increase in gastric carcinoma following the removal of the dietary restrictions imposed by World War I. yet in England the disease is said to be more common among the poor than the well-to-do (26). Moreover, the rate here is strikingly higher for North Wales, where the

diet is deficient in fresh milk and vegetables and leans heavily toward fried foods (6)

In evaluating these data, the short life expectancy among the Mexicans, Eskimos, Hindus and Russians must be taken into account.

GEOGRAPHIC DISTRIBUTION

Carcinoma of the stomach supposedly has its greatest frequency in the United States, Great Britain, Germany, Scandinavia, Holland, France, Switzerland, Czechoslovakia, Japan and Australia. It is reputedly less common in Russia, China, Mexico and South America and is virtually unknown among Alaskan Eskimos, Arabs, Indians, Afghans and African negroes.

Do these last-named peoples really enjoy immunity to cancer of the stomach? It is noteworthy that all of the areas with low incidence rates are regions where life expectancy is low and the facilities for recognition and registration of the disease poor. The recorded incidence for China, for example, is negligible, yet the rate for the Chinese in the Dutch East Indies is comparable to that in the Western Hemisphere. The Hindus exhibit a similar phenomenon with a low rate in India (24-35) and a much higher one in Dutch Guinea (55).

In other words, as hospital facilities are provided and reliable statistics become available a higher incidence of gastric carcinoma is manifest. Thus, in Korea 75 of 150 cases of operable neoplasms admitted to Severance Hospital Seoul were diagnosed as gastric cancer (31). An even larger percentage (53-36) was cited in a Japanese report on 28,015 cancer fatalities (20). In China carcinoma of the stomach was found in 4.7 per cent of the tumor cases admitted to hospitals in the various provinces (15).

At the Memorial Hospital 388 foreign-born patients with gastric carcinoma were seen in the 30 year period from 1916 through 1946 (Table VII). Their distribution, with respect to nation of origin did not fall into any of the prescribed patterns. Thus Mexicans, and Central and South Americans, who constitute only 1.4 per cent of the foreign-born population of New York City formed 2.8 per cent of the alien patients, although their native countries report a low incidence rate for cancer of the stomach. Great Britain, the Scandinavian countries and Germany on the other hand with reputedly high rates contributed less than their proportionate number. The striking disparity between the percentage of Russian patients and the size of the Russian population is probably due to the fact that most of the former were not ethnically Russians but Russian Jews. In a city such as New York the existence of hos-

TABLE VII.—COUNTRY OF BIRTH PATIENTS WITH GASTRIC CANCER SEEN AT THE MEMORIAL HOSPITAL NEW YORK, N.Y. 1916 THROUGH 1946 AND THE FOREIGN BORN POPULATION IN THE CITY OF NEW YORK, 1940

Country of birth	Memorial Hospital 1916 through 1946		New York Census of 1940 (World Almanac, 1947)	
	Number	Per cent	Number	Per cent
Total	388	100.0	2,080,000	100.0
Canada	1	1.3	40,341	1.9
West Indies, Mexico, and Central and South America	5	1.3	18,745	1.4
British Isles	71	18.0	370,540	17.8
Scandinavian Countries	19	4.9	70,7	3.4
Western Europe	20	5.2	18,031	8.7
Germany	80	20.6	14,740	7.1
Poland	76	19.6	104,153	5.0
Russia	124	31.9	415,101	19.9
Austria, Hungary, Czechoslovakia	30	7.7	134,578	6.5
Mediterranean Countries (Greece, Yugoslavia, Greece, Bulgaria, Rumania)	60	15.5	475,877	22.8
Deluxe Countries (Siberia, Japan, Korea, China, India, etc.)	17	4.4	70,395	3.4
The Near East	3	0.8	16,16	0.8
Japan, China, and Korea	3	0.8	1,07	0.05
Australia			987	0.05
Other European Countries			5,737	0.3
All others and not reported			1,68	0.08

pitals dedicated to the services of specific national groups somewhat upsets the normal distribution of patients and makes it more difficult to correlate incidence to national origin. However this enhances, if anything, the disproportion between foreign born and native-born patients in our series. In 1940 the population of New York 7,454,995 was divided into 72.1 per cent native-born, of whom approximately half were of alien parentage and 27.9 per cent foreign born. Our 185 patients more than reversed this proportion with 74.9 per cent foreign-born patients to 25.1 per cent native-born.

DISTRIBUTION WITHIN THE UNITED STATES

In 1940 the crude death rate for cancer and other tumors in the United States was 125.2 per 100,000. The corresponding figure for gastric carcinoma was 19.8 with the greatest number of cases occurring in the Eastern, Northeastern, West Cen-

TABLE VIII.—DEATH RATE FROM GASTRIC CANCER IN THE UNITED STATES, 1940 RATE PER 100,000 POPULATION

Rate per 100,000	Number of states	States					
Under		Alabama	9.7	Mississippi		Minnesota	
		Arizona	5	New Mexico	1	Montana	5
		Arkansas	6	N. Carolina	9.7	Nebraska	
		Florida		Oklahoma	14	N. Virginia	14
		Georgia	9	S. Carolina	9.8		
5-19	7	Delaware	8	Kentucky	5.5	Utah	5
		Indiana	8.5	Louisiana	5	Wyoming	18.3
		Iowa	8.6				
20	9	California	3	Michigan	21.6	New York	23.6
		Colorado		Missouri	20.3	Ohio	21
		Connecticut	5	Montana	3	Pennsylvania	21.3
		Idaho	9	N. Dakota	24.5	Rhode Island	24
		Illinois		N. Hampshire	8	S. Dakota	22.4
		Iowa	3	New Jersey	22	Vermont	21
		Maryland					
20	4	Mass.	24	Vermont	5	Washington	26
		Massachusetts	26	N. Dakota	5	Wisconsin	23
		Minnesota	20.4	Oregon	26		

tral, North Central, and Far Western states and the fewest in the deep South¹ (Figs. 1 and 2).

If the crude death rate for malignant disease of the stomach is analyzed for various sections of the country it displays an unmistakable dependence upon life expectancy, the facilities for medical care and the general sociological level (Tables VIII-XII). Urban or rural life *per se* does not appear to influence the incidence of gastric carcinoma, but the poor hygienic, educational and economic conditions which prevail in certain rural areas, notably the deep South do. They militate against the long span of life favorable to the disease and against its detection when it occurs. Comparable conditions elsewhere in the world produce comparable results, i.e., a low imputed incidence which does not reflect the true frequency or potential frequency of the disease.

New England and North Atlantic states. (Vermont, Massachusetts, New York and Pennsylvania)

In the four states selected as a sample for this group the death rate for gastric cancer ranged between 21.2 per 100,000 for Vermont and 26.5 for Massachusetts. This was above the figure for the country as a whole, undoubtedly reflecting the high

degree of longevity and exceptional concentration of physicians (2), hospital beds (27) and medical schools (28) in this region (Table XIII). All four states fall in the two top categories for provision of medical care and have nineteen recognized medical schools within their boundaries.

Cancer of the stomach occurs with increasing frequency after the fifth decade of life. In 1940 the United States as a whole had an "over 50" population of 20.4 per cent. For the selected states the figure varied from 20.9 per cent in Pennsylvania to 24.4 per cent in Vermont. Compare this with 14.9 per cent for Alabama, 15.2 per cent for Mississippi, and 15.4 per cent for Georgia, and it is seen that far more people in the New England and North Atlantic states reach an age at which cancer of the stomach might be expected to occur.

With the exception of Vermont, the population of the selected states was overwhelmingly urban (57). In New York, 83.8 per cent of the population lived in the larger cities; in Massachusetts, 80.4 per cent; and in Pennsylvania 66.5 per cent. Vermont was alone with a rural population of 65.7 per cent.

It is interesting to compare the 21.2 per 100,000 death rate from gastric cancer for this state with the figure of 9.7 for Alabama, where 69.8 per cent of the population lived under rural conditions, and 9.9 for Georgia, with a rural population of 65.6 per

¹From the period from 1935 to 1940 to that from 1941 to 1945, the Metropolitan Life Insurance Company reported a drop of 6 per cent in its death rate from gastric cancer for all males, and 1.4 per cent for white females (26).

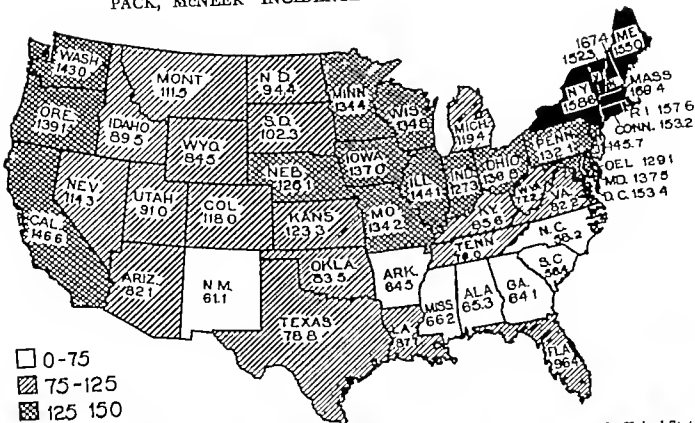


Fig. 1. Death rate from cancer and other malignant tumors (all types) in the United States, 1940. Crude death rates per 100,000 population

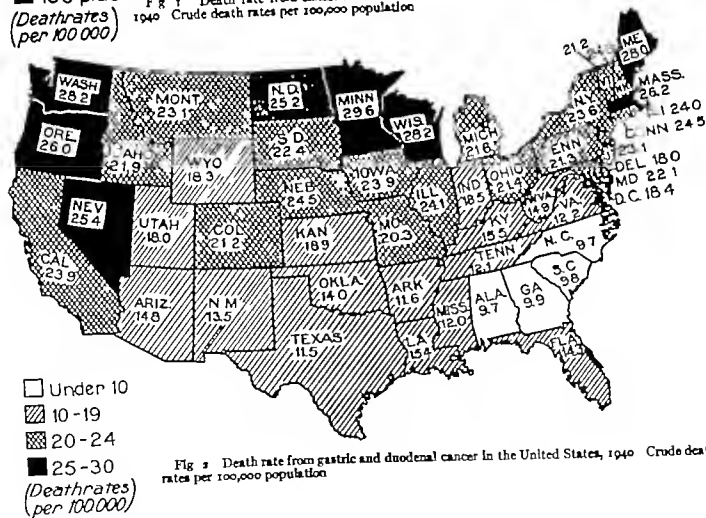


TABLE IX.—PER CENT OF URBAN POPULATION IN THE UNITED STATES 1940

Per cent of urban population	Number of states	States
65 per cent or more		California, Connecticut, Illinois, Massachusetts, Michigan, New Jersey, New York, Ohio, Pennsylvania, Rhode Island
50-64 per cent		Colorado, Delaware, Florida, Indiana, Maryland, Missouri, New Hampshire, Utah, Washington, Wisconsin
35-49 per cent	14	Iowa, Kansas, Louisiana, Maine, Minnesota, Montana, Nebraska, Nevada, Oklahoma, Oregon, Tennessee, Texas, Virginia, Wyoming
5-34 per cent	14	Alabama, Arizona, Arkansas, Georgia, Idaho, Kentucky, Mississippi, New Mexico, North Carolina, North Dakota, South Carolina, South Dakota, Vermont, West Virginia

cent (Table XII). The disparity is undoubtedly explained by the difference in life expectancy and opportunities for comprehensive medical care. *Central and Midwestern states* (Ohio, West Virginia, Illinois, Missouri, Minnesota, Kansas, Michigan, and North Dakota).

The correlation between short life expectancy and a diminished incidence of cancer of the stomach is strikingly demonstrated in this group of states. In West Virginia, where 16.1 per cent of the population have passed the age of fifty, the mortality was 14.9 compared to 25.1 in North Dakota, where 19 per cent of the population survived the fifth decade. The rural population of these states was, respectively 71.9 and 79.4 per cent. The higher incidence in North Dakota was probably bolstered by its larger proportion of hospital beds, one to every 253 persons, compared to one in every 359 in West Virginia. On the other hand, the latter had a somewhat larger ratio of physicians.

A similar relationship emerges when predominantly rural North Dakota is compared to states with a large urban population viz. Illinois (73.6%) and Michigan (65.7%). With 22.1 per cent of its population in and past the sixth decade of life Illinois had a death rate of 24.1 per 100,000 from gastric cancer while Michigan, with 19.8 per cent of its residents over 50 years of age, had a mortality of 21.6. In spite of the varying ratios of urban to rural population, all of these states had important factors in common viz. a high degree of longevity, a superior economic and educational status

and easy access to first class medical facilities. Illinois and Michigan have seven medical schools between them and respectively provide a hospital bed for every 277 and 238 persons.

Missouri and Minnesota with almost equally divided urban and rural populations, complete the comparison. With 23.5 per cent of its population over 50 years of age the former had a death rate of 20.3 per 100,000 and the latter with an over 30.1 population of 21.0 per cent, a mortality of 29.6. The seeming disproportion in favor of Minnesota may be accounted for by its more favorable ratio of physicians and hospital beds, plus the unusual concentration of patients with gastro-intestinal cancer at the Mayo Clinic.

Far Western states (Wyoming, Washington and California)

Again in this section the distribution of urban and rural communities afforded no key to the incidence of gastric cancer. Wyoming, with a rural population of 62.7 per cent, had a death rate of 18.2 compared to 23.9 for California, with a rural population of 29 per cent, and a high of 28.2 for Washington, with a 46.9 per cent rural population.

The distribution of medical facilities was also inconclusive. Washington, with no medical colleges at the time of these statistics, one hospital bed to every 232 persons, and one physician to every 789 had a higher recorded incidence than California, with four medical schools, a hospital bed for every 187 residents and a physician for every 580 persons. Although Wyoming apparently provides ample hospitalization (a bed to every

TABLE X.—RATIO OF GENERAL HOSPITAL BEDS TO POPULATION IN THE UNITED STATES, 1940

Ratio of hospital beds to population	Number of states	States
1:50-1:40 persons	16	Arizona, California, Colorado, Delaware, Maryland, Massachusetts, Michigan, Montana, Nevada, New Hampshire, New Mexico, New York, Rhode Island, Vermont, Washington, Wyoming
1:30-1:49 persons	12	Connecticut, Florida, Idaho, Illinois, Kansas, Louisiana, Maine, Minnesota, Missouri, Nebraska, New Jersey, North Dakota, Oregon, Pennsylvania, South Dakota, Utah, Virginia, Wisconsin
1:20-1:49 persons	9	Alabama, Indiana, Iowa, North Carolina, Ohio, Oklahoma, South Carolina, Texas, West Virginia
1:10 persons or more	5	Arkansas, Georgia, Kentucky, Mississippi, Tennessee

TABLE XI.—RATIO OF PHYSICIANS TO POPULATION IN THE UNITED STATES 1940

Ratio of physicians to population	Number of states	States
1,400-500 persons	4	California, Colorado, Massachusetts, New York.
500-100 persons	3	Connecticut, Delaware, Illinois, Maryland, Minnesota, Missouri, Nevada, New Hampshire, New Jersey, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, Washington.
300-100 persons	5	Arizona, Florida, Indiana, Iowa, Kansas, Louisiana, Maine, Michigan, Nebraska, Oklahoma, Texas, Utah, Virginia, Wisconsin, Wyoming.
11,000 persons or more	14	Alabama, Arkansas, Georgia, Idaho, Kentucky, Mississippi, Montana, New Mexico, North Carolina, North Dakota, South Carolina, South Dakota, Tennessee, West Virginia.

193 people) it has a low rate of physicians—one to 915

Longevity figures provide better correlation. In Washington where the fatalities from gastric cancer were highest, 24.9 per cent of the population survived the half century mark. California was second both in mortality and length of life. With the lowest incidence Wyoming also had the shortest life span with only 17.9 per cent of its population past the age of 50

TABLE XII.—POPULATION FACTORS AND FACILITIES FOR MEDICAL CARE IN RELATION TO DEATH RATE FROM GASTRIC CANCER.

United States and Twenty Selected States, 1940

State	Death rate per 100,000	Ratio population.		Per cent of urban population
		Physicians	Hospital beds	
United States	19.8			
Massachusetts	16.1	547	98	89.4
Vermont		687	37	34.3
New York	3.6	497	3	8.3
Pennsylvania	1.3	71	8	66.5
Ohio	4	74	153	66.8
West Virginia	4.0	207	150	18
Illinois	24	648	277	73.6
Missouri	20.5	714	3.6	83.8
North Dakota	5.2	50	5	6
Minnesota	19.6	797	21	49.6
Michigan	6	870	38	65.7
Kansas	8.9	870	277	41.0
California	13.0	1,380	87	7.10
Washington	18	1,786	3	53
Wyoming	6	105	93	37.3
Texas	11.5	1,030	4.5	43.4
Georgia	9.9	11,106	483	34.4
Mississippi		12,450	600	9.8
Alabama	9.7	11,364	41	30
Louisiana	14	950	273	41.5

Southern and Southwestern states (Georgia, Mississippi, Alabama, Louisiana, and Texas)

The extremely low recorded death rate for gastric cancer in these states (9.7 per 100,000 in Alabama, 9.9 in Georgia, 11.5 in Texas, 12.0 in Mississippi, and 15.4 in Louisiana) is a corollary of short life expectancy, insufficient public health education, and proportionately few medical institutions. This is a predominantly rural region with a large proportion of negroes, the rural population ranges from 54.6 per cent in Texas to a high of 80.2 per cent in Mississippi. Medical facilities are not as universally available as in other sections; there is only one physician to more than 1,000 persons in Georgia, Alabama, and Mississippi, and only a slightly better ratio in Texas and Louisiana. Hospital beds are also inadequate for the most part; only Louisiana provides a bed for fewer than 300 persons, while Georgia and Mississippi are in the lowest category, with one bed to 483 and 649 persons, respectively. Mississippi is without a medical school.

The 1940 longevity for this section was considerably below the average of the country as a whole. Whereas 20.4 per cent of the general population lived more than five decades, the corresponding percentage for Alabama was 14.9, Mississippi 15.2, Louisiana and Georgia 15.4, and Texas, 16.6. These figures run fairly parallel to the low mortality rates for gastric cancer and the lower educational and public health level of the states in question.

It is our belief that the apparent gross variations in the incidence of gastric cancer in different parts of this country—and indeed throughout the world—do not reflect a genuine difference in susceptibility as much as variations in the general sociological plane. With the establishment of adequate medical facilities and education of the public in their early use, the disease is more frequently diagnosed and a higher morbidity rate recorded. At a common level of longevity, economic security, and public health education and opportunity, it is probable that the incidence of gastric cancer would be approximately the same the world over.

TABLE XIII.—DEATHS FROM CANCER OF THE GASTROINTESTINAL TRACT

Location	United States		England and Wales		Australia		Germany	
	Number	Per cent	Number	Per cent	Number	Per cent	Number	Per cent
Digestive organs and peritoneum	25,743	00	39,79	80	4,447	00	43,907	00
Esophagus	1,809	3.9	1,17	6.3	162	6	2,433	5
Stomach and duodenum	20,110	36.3	2,403	36.4	2,176	4.6	15,17	33.1
Intestines	17,797	24.6	9,066	47.3	1,093	5.5		
Rectum			5,780	17			5,379	6.1
Rectum and anus	1,866				43			
Liver and biliary tract	9,747	14	1,07	7.6	11	7.6	9,143	16
Pancreas	1,657	7	6,1	5.6	167	6.3	1,000	9
Mesentery and peritoneum	1,043							
Omentum and peritoneum					44			
Peritoneum			283					
Other abdominal sites							187	9
Other and unspecified sites	609	6			7		7,008	1

United States, *Ninth Census*, p. 90. Vital Statistics Rates in the United States, 1900. Table 4, p. 402. Government Printing Office, Washington, D. C. 1911.

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Germany. *Statistik des Deutschen Reichs*. Band 237. Teil 1: 1900-1910. Die Ursachen der Sterblichkeit im Deutschen Reich im Jahre 1910. Berlin, 1911.

SOCIOLOGICAL FACTORS

In contrast to the apparent preponderance of gastric carcinoma in regions on a high plane of industrial and medical development, there is evidence that the disease is actually more common at the lower social levels (11 33 54 63). At the ages 35 and 36 standardized mortality ratios for cancer of the stomach and esophagus in England and Wales (1930 to 1932) showed an increase in incidence with each descent of the social scale. The rate rose from 114 for the professional and independent class to more than double (248) for unskilled labor.

Bavarian statistics tell a similar story (7). Carcinoma of the stomach accounted for 70.6 per cent of all cases of malignant tumors among agricultural workers and for 66 per cent among artisans. As the social and economic level rose, the proportion lessened, reaching 39 per cent for brewers and publicans, 29.6 per cent for merchants, and a low of 24.2 per cent for clerics.

Other German observers (Mahlisch) cite a rate of from 30 to 36 per cent for people who "live well" as compared to 54 per cent for those in less fortunate circumstances. According to their experience, gastric cancer is relatively rare among the well to do.

In contrast to those observations are insurance reports (Hoffman, 25) showing a distinctly higher mortality from neoplasms of the stomach among

ordinary policyholders than among the poorer industrial risks. On the basis of gastric analysis, Lintott found no constitutional difference between the stomachs of the rich and the poor.

The paucity of authoritative data on this aspect of the incidence of gastric carcinoma underlines the need for more uniform and comprehensive records. In addition to age, sex, and race, occupation might profitably be included as a regular feature of case histories.

RATIO OF GASTRIC CANCER TO OTHER NEOPLASMS OF THE DIGESTIVE TRACT

Of all the organs of digestion, the stomach is most vulnerable to carcinomatous invasion (Table XIII). The intestines hold second place, although the duodenum is rarely attacked.

In 1940 in the United States, malignant tumors of the digestive tract and peritoneum represented 53.2 per cent of the total cancer deaths. Gastric cancer predominated in this group (36.5%) with carcinoma of the intestines second (24.5%). New growths of the liver and biliary passages (13.4%) and of the rectum and anus (12.2%) were next in importance.

Great Britain showed approximately the same distribution, with the stomach and the duodenum the primary sites in 36.4 per cent of the fatal neoplasms of the digestive organs and peritoneum. Cancer of the intestines, other than the duodenum,

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TABLE XIV — DISTRIBUTION OF CANCER OF THE GASTROINTESTINAL TRACT
Memorial Hospital, New York New York.

Location	1944		1945		1946	
	Number	Per cent	Number	Per cent	Number	Per cent
Total	169	100	45	100	804	100
Esophagus	15		28		9	1.1
Diaphragm, peritoneum, mesentery and associated abdominal cancer						
Stomach	1	24.6	5		0	2.8
Liver, gall bladder and ducts	9	0			99	9.6
Pancreas	7	5	6	3	9	7
Spleen						
Small Intestines						
Large Intestines, right	24	5	25	7.8	40	7.9
Large Intestines, left	40	5	31	7.8	40	7.9
Large Intestines, generalized						
Rectum and anus	4				1	0.6
	102	4.7	66	30	25	44.8

ranked second (27.1%) with rectal carcinoma third (15.7%). New cancers of the liver and bile passages played a less important role than in the United States, causing only 7.6 per cent of the mortality of the gastrointestinal tract.

In Germany the stomach and duodenum were the seat of an exceptionally large proportion (55.3%) of the fatal neoplasms of the digestive tract. Cancer of the liver and gall bladder caused 16.0 per cent of the deaths in this category, cancer of the rectum 8.3 per cent.

Australian figures approached the American and British, with gastric and duodenal carcinoma causing 42.8 per cent of the deaths attributable to malignant tumors of the digestive organs, and cancer of the intestines 25.8 per cent. The mortality from neoplasms of the liver and biliary passages was low (7.6%) as in Great Britain.

For the incidence of cancer of the gastrointestinal tract in morbidity statistics, patients treated at the Memorial Hospital for selected years are presented in Table XIV. The distribution according to the site of the cancer may be determined to some extent by the number of beds assigned to the different services and the difference in length of time required for hospitalization.

INCIDENCE OF GASTRIC CARCINOMA IN RELATION TO OTHER GASTROINTESTINAL DISEASES

Little has been published on the frequency of gastric neoplasms in comparison to other diseases

of the digestive tract. In one series of 3,000 patients presenting gastrointestinal symptoms, 15 per cent had organic disease of the stomach or duodenum, distributed as follows: 9.8 per cent, duodenal ulcer; 1.6 per cent, gastric ulcer; and 3.1 per cent, gastric carcinoma, less than one per cent comprised benign lesions (10). In other words, many of all organic lesions found.

At the Toronto General Hospital, 1,724 admissions for chronic gastrointestinal disease yielded 227 cases (13.2%) of gastric cancer (18). This diagnosis was established in 8.7 per cent of the report as a group of 1,869 private surgical cases. In the hospital series, chronic gall bladder disease was 2.6 times as prevalent as carcinoma of the stomach and duodenal ulcer 3.0 times as common. Gastric cancer revealed approximately the same relationship except for a higher proportion of chronic gall bladder disease (4.4 to 1).

Still another report on 1,000 cases (44) disclosed a comparable distribution of gastric ulcer (3.1%), duodenal ulcer (17.1%) and gastric cancer (7.1%).

SUMMARY

1. Cancer is not a reportable disease with the result that no all inclusive figures on its occurrence are available.

2. The reported incidence of gastric cancer throughout the world with but few exceptions varies directly with the economic status, educational and medical facilities, and life expectancy of the community or country.

3. Fatalities from cancer of the stomach reach their highest level between the sixty fifth and seventieth years although 4.7 per cent of the deaths took place between the thirtieth and forty fourth.

4. A most striking rise in the crude death rate from gastric cancer among negroes was noted.

5. The disease was shown to be slightly more prevalent among non-Jews than Jews in European cities.

6. Of all the organs of digestion the stomach is the most vulnerable to the occurrence of cancer.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

EYE

Experimental Study and Comparison with Ocular Effects on Freezing. W. MORTON GRANT. *Arch. Ophth., Chic.* 1947 35 762.

The author states that it is the chemical not the refrigerant, properties of liquid sulfur dioxide which are primarily responsible for damage to the cornea. Sulfur dioxide exerts its toxicity principally in the form of sulfurous acid. Sulfur dioxide produces an acid burn in the eye.

Freezing of the anterior part of the living eye of the rabbit for several seconds resulted in a mild and transient disturbance. Freezing for 30 to 90 seconds caused loss of the endothelium with consequent edema of the stroma and epithelium, changes unlike those produced in accidental injury of the eye with liquid sulfur dioxide.

Sulfur dioxide exerts its toxic effect principally in the form of sulfurous acid. No significant production of sulfonic acid was detected.

The epithelium and stroma of the cornea have a relatively high permeability to sulfur dioxide. This is related to the lipid solubility of sulfur dioxide.

Contrary to previous opinion, production of injury by liquid sulfur dioxide is not attributable to freezing or to the formation of sulfonic acid, but to its ready penetration of the corneal epithelium in high concentrations and its action principally as sulfurous acid in denaturing corneal proteins including enzymes.

JOSHUA ZUCKERMAN M.D.

Surgical Correction of Superior Oblique. W. P. McGUIRE. *Am. J. Ophth.* 1948 31 65.

Paralysis of the superior oblique muscle is the most frequent individual extraocular muscle condition next to paralysis of the external rectus muscle. Complete paralysis of the superior oblique is rare under action or paresis is common.

It is characterized by (1) habitual torticollis with the head most frequently tilted toward the side opposite to that of the paretic muscle, (2) vertical diplopia which increases when the paretic eye is carried downward and inward (3) hypertropia which increases when the eye is carried into the field of action of the paretic superior oblique muscle. Nausea and vomiting may occur.

Before 1934, at which time Wheeler described his operation, the condition was corrected by attacking the yoke or the direct antagonistic muscle by tenotomy of the inferior oblique of the same eye, and by (the less popular) recession of the superior rectus of the same eye. In a few cases the homolateral inferior rectus muscle was advanced.

The most logical procedure for the relief of the symptoms is operation on the paretic muscle itself—resection of the tendon of the superior oblique. There are no definite rules as to the amount of tendon to be resected but immediate overcorrection is desirable. If this procedure fails then other methods may be tried. However secondary procedures are seldom necessary.

JOSHUA ZUCKERMAN M.D.

Intraocular Foreign Bodies in Soldiers. HELENER CAMPBELL WILDER. *Am. J. Ophth.* 1948 31 57.

Foreign bodies of many types were found in eyes of soldiers following injury during training and combat. Of these, 37 per cent were magnetic, 62 per cent were nonmagnetic, and 1 per cent were mixed.

It is concluded that nonmagnetic intraocular foreign bodies predominate in military injuries. However many injured eyes do not reach the laboratory because a foreign body may have been successfully extracted by a magnet and even in enucleated eyes nonmagnetic foreign bodies are often secondary to ferrous missiles which may have been extracted.

Associated infections and reactions often occur. Infection was generally due to the staphylococcus resulting in purulent panophthalmitis. Reaction associated with siderosis bulbi was mild. Sympathetic ophthalmia developed in 4 cases of retained nonmagnetic foreign bodies and in one case of ferrous foreign body. Glaucoma occasionally occurred in association with siderosis bulbi and in cases in which the foreign body was lodged in the anterior chamber. However, glaucoma was a comparatively rare end result and phthisis bulbi a common end result. Granuloma surrounded any kind of foreign body.

JOSHUA ZUCKERMAN M.D.

Ocular Injury Due to Sulfur Dioxide. I Report of 4 Cases. W. MORTON GRANT. *Arch. Ophth., Chic.* 1947 35 755.

The author discusses ocular injury caused by sulfur dioxide. Sulfur dioxide in high concentration in the form of the liquefied gas is commonly used in domestic refrigerators. It is an occasional cause of serious injury to the eye.

Sulfur dioxide may cause immediate alterations in the cornea, due (as in acid burns) to opacification of the corneal epithelium which remains adherent to the stroma. At first damage to the corneal nerves with resultant anesthesia causes only slight discomfort. Several hours, or days, later the vision becomes blurred, the eyelids swollen, and the conjunctival vessels thrombosed. Still later when the opaque corneal epithelium is lost and better vision occurs evidences of deeper injury—edema of the stroma.

opacity of the corneal nerves, and a grayness and irregularity of the endothelium—become visible. Such changes resemble those produced by burns with alkalis. Infiltrates in the stroma, vascularization of the interstitial tissue, and moderate thickening of the stroma are common.

Corneal scarring, conjunctival overgrowth of the cornea, and the formation of symblepharoid are the most frequent complications. Iritis or glaucoma did not occur.

It is emphasized that, contrary to general belief sulfur dioxide is not innocuous. In 4 reported cases, spraying of liquid sulfur dioxide and oil into both eyes resulted in immediate damage to the corneal epithelium as in acid burns, and to the underlying stroma and the endothelium as in alkali burns.

In mild cases complete recovery occurs in severe cases dense opacification follows infiltration in the cornea and vascularization of the interstitial tissue.

JOSIEA ZUCKERMAN, M.D.

Data on the Occurrence of Calcification in the Eye
TISSENA. MAGDA RADNOT *Brit. J. Ophth.* 1945, 38: 47

The author collected 12 cases of calcareous degeneration of the cornea. In 2 of the patients, lime was deposited in the cornea in an irregular form and in 10 as a zonular opacity. In the cases of zonular opacity calcareous deposits were found in the region of Bowman's membrane and in the form of discs in layers under it. In most cases hyaline granules could also be found beside the calcareous lamellae. In the advanced cases the calcification was extensive and Bowman's membrane was lacking.

On the basis of these 12 cases the author describes the concomitant occurrence of lime in other eye tissue. Lime was frequently found in the choroid as bone lamellae. Calcareous degeneration was observed in lenses. Deposits of lime in a degenerate retina or in a chorioretinal scar were rare.

ROGER H. JOHNSON, M.D.

Corneal and Conjunctival Pigmentation among Workers Engaged in the Manufacture of Hydroquinones. BARKS ANDERSON *Arch. Ophth.* Chic. 1947 35: 2

The author presents a survey on the incidence and severity of corneal and conjunctival pigmentation in workers engaged in the manufacture of hydroquinone. From these patients the author has reconstructed the sequence of events in this condition. After about 3 years of exposure to hydroquinone vapor a brownish tinge against the normally white sclera in the interpalpebral portion is noted. The conjunctiva in these areas appears slightly dried and to have a white frothy foamlike deposit attached to it. The deeper portions of the conjunctiva acquire a light-brownish sepioid stain. The cornea remains clear.

After 2 or 3 more years the conjunctiva appears thicker and drier and small discrete dark brown to yellowish granules or globular precipitates are ob-

served in the deeper structures. Some migration of pigment from the limbus into the cornea can usually be observed at this time.

After a total of 5 or more years of exposure, the following picture is frequently found. Involvement is always limited to the interpalpebral zone of both the conjunctiva and the cornea. In the superficial layers of the conjunctiva fine glasslike spherules are found along the course of the superficial veins. Fine discrete brownish granules in sizes up to one millimeter are noted and extend down as deep as the basal epithelial cells where the larger granules are found. In the cornea just under or above Bowman's membrane are many fine grayish translucent and highly refractive dots. Vertical wrinkles are frequently found in Descemet's membrane. Two types of pigmentation are noted: (1) many fine dark brown to yellowish granules, and (2) a greenish-yellow homogenous stain permeating the entire anterior layers of the cornea. Small scarred areas are seen lying beneath the epithelium. The cornea becomes roughened though it does not stain with fluorescein. The terminal nerve filaments appear enlarged and may account for the frequent hyperthemia.

It was found that the age of the individual and length of employment, correlated with the degree of exposure, was the most constant factor in determining the degree of injury. The prognosis is not good in that, while conjunctival and corneal staining tend to disappear after a time, there is permanent scarring of the cornea and damage to vision. There seems to be no treatment other than prevention.

ROGER H. JOHNSON, M.D.

Treatment of Perforated Corneal Ulcer by Antoplastic Scleral Transplantation. SVEN LARSSON. *Brit. J. Ophth.* 1945, 38: 54.

Following the transcranial removal of a retrolental hemangioma in a 7 year old girl a lagophthalmic corneal ulcer developed into a descemetocoele. Four attempts to close this lesion with a conjunctival flap were of no avail. Since the lesion was off center an opaque transplant could be used. Therefore, a 2.5 millimeter scleral disc was removed from just below the external rectus muscle of the involved eye. The corneal defect was cleaned and enlarged and the scleral disc was fitted into the hole. A conjunctival flap was thrown over it. The disc healed in place and the final vision was comparatively good.

ROGER H. JOHNSON, M.D.

Solar Retinitis. EDWARD ROSEN *Brit. J. Ophth.* 1948, 31: 3.

Various cases of solar retinitis as presented by other authors were reviewed. These patients had had a visual loss following looking into the sun or at a welding flash.

The author describes a patient who following prolonged gazing directly into the sun, had had a considerable loss of vision in each eye. Fundus examination 6 weeks later showed each macula to have a peculiar greenish color with a pigment halo just

around the foveal reflex. Anterior to the foveal depression was a small, whitish-gray fluffy area. The picture was bilateral. The whitish areas disappeared in 10 days and the maculae became darkened. Five weeks later a definite hole had appeared in each macula. These holes were surrounded by a pigmented ring.

The author reported 23 cases with a macular hole or holes. All these patients had reduced vision and usually had a history of watching the sun directly but occasionally of watching reflected sun. He believes medical education for the prevention of these holes is important.

ROGER H. JOHNSON, M.D.

Surgical Treatment of Syphilitic Primary Atrophy of the Optic Nerves (Syphilitic Optochiasmatic Arachnoiditis): A Clinical-anatomic Study. WATKINS L. BRUNZSCH. *Arch. Ophth.*, Chic., 1947, 38, 735.

The author discusses the propriety of surgical intervention in patients with primary syphilitic atrophy of the optic nerves due to syphilitic optochiasmatic arachnoiditis. The discussion is based on a histologic study of 12 cases.

Four patients presented no arachnoidal adhesions at all. In 2 cases some slight arachnoidal thickening was observed which was considered normal and 6 cases presented definite syphilitic arachnoiditis in the optochiasmatic region. Although grossly these 6 cases presented pronounced thickening of the arachnoid embracing the optic nerves the chiasm and at times the third and other cranial nerves. Microscopic examination revealed that the thickened arachnoid passed harmlessly over the optic nerves and chiasm without pressure on the optic nerves.

It is pointed out that primary syphilitic atrophy of the optic nerve is the result of an inflammatory process in the intracranial part of the optic nerve and chiasm which originates in a basilar syphilitic meningitis. Only in some cases is an optochiasmatic arachnoiditis produced.

It is concluded that surgical removal of the arachnoidal adhesions is of little if any benefit because the inflammatory process within the optic nerves and chiasm remains unaltered by the operative procedure.

The most efficacious treatment for this condition is malarial therapy aided by a course of concomitant and subsequent injections of penicillin—5,000,000 units in each course. JOSHUA ZUCKERMAN, M.D.

EAR

Further Observations on Temporary Deafness following Exposure to Gunfire. G. REID, *J. Laryngol.*, Lond., 1946, 61, 609.

This report is a continuation of an earlier article on the same subject, but gives the results in greater detail than the first one.

It is stated that the experiments were carried out with a blank rifle cartridge fired a certain distance

from the patient's ear and that about 15 minutes after the test an audiogram was taken. The author gave the distances of the muzzle of the rifle from the subject and also the possible variables that might have been present in production of the noise.

It was found that the average hearing loss for each subject usually increased steadily as each round was fired until with some subjects, further shots at the same intervals caused only slight further increase in deafness. The author showed that the noise usually effected one frequency and as further rounds were fired to the same subject other frequencies above and below were affected.

It was proved that some men are much more sensitive to the noise than others and that it is not possible to determine which subject is sensitive and which is not. There was no evidence that the size or shape of the external auditory canal or the position of the pinna relative to the head is of any importance in causing the variation of sensitivity from one subject to the other. One possibility is the presence or absence of a plug of cerumen which, when present, may cause less sensitivity.

It is shown in the discussion and by experimental proof that the sensitivity of a certain subject may vary according to whether or not he has had previous exposure to loud sound. The author gives briefly the possible reasons why the same individual may have less sensitivity in sound after repeated exposures.

The author shows that very rapid fire causes less deafness than a slow rate of fire and gives possible explanations for this. He shows that a moderately rapid rate of fire affects the frequencies of 4096 and above while the slow rate of fire seems to produce its main effect in the frequency range between 2048 and 4096 complete vibrations per second.

All gunfire regardless of the type, affects mainly the high tones and the results depend upon the individual rather than the gun and there is no characteristic audiogram that can tell the type of noise which produces the deafness.

The time of recovery is shortest in the lowest frequency and longest in the highest frequencies. When the deafness is severe there is usually a lag of several hours before recovery begins in the upper frequency and occasionally the deafness increases after exposure before recovery begins. After recovery sets in, its rate follows a roughly exponential curve. The last frequency to recover was usually either 9747 or between 4096 and 5993 c.p.s. Usually the patients with audiograms showing peak losses between 30 and 40 decibels recovered in 24 to 48 hours and those with losses of 30 decibels recovered in a few hours and sometimes within 1 hour. In the review of the recovery curves the impression was sometimes obtained that certain frequencies passed through a phase of hypersensitivity before settling down to the pre-exposure level.

The study of the recovery curve leads to the consideration of the mode of onset of permanent deafness. In the cases presented no serious permanent loss of hearing was produced by the exposure to the

opacity of the corneal nerves and a grayness and irregularity of the endothelium—become visible. Such changes resemble those produced by burns with alkalis. Infiltrates in the stroma, vascularization of the interstitial tissue, and moderate thickening of the stroma are common.

Corneal scarring, conjunctival overgrowth of the cornea, and the formation of symblepharon are the most frequent complications. Intus or glaucoma did not occur.

It is emphasized that, contrary to general belief sulfur dioxide is not innocuous. In 4 reported cases spraying of liquid sulfur dioxide and oil into both eyes resulted in immediate damage to the corneal epithelium, as in acid burns and to the underlying stroma and the endothelium as in alkali burns.

In mild cases complete recovery occurs; in severe cases dense opacification follows infiltration in the cornea and vascularization of the interstitial tissue.

JOSUUA ZUCKERMAN, M.D.

Data on the Occurrence of Calcification in the Eye
 Tlamos. MAGDA RADNOT. *B.H.J. Ophth.* 1948,
 32: 47

The author collected 12 cases of calcareous degeneration of the cornea. In 2 of the patients lime was deposited in the cornea in an irregular form, and in 10 as a zonular opacity. In the cases of zonular opacity calcareous deposits were found in the region of Bowman's membrane and in the form of discs in layers under it. In most cases hyaline granules could also be found beside the calcareous lamellae. In the advanced cases the calcification was extensive and Bowman's membrane was lacking.

On the basis of these 12 cases the author describes the concomitant occurrence of lime in other eye tissue. Lime was frequently found in the choroid as bone lamellae. Calcareous degeneration was observed in lenses. Deposits of lime in a degenerate retina or in a chorioretinal scar were rare.

ROGER H. JORDON, M.D.

Corneal and Conjunctival Pigmentation among Workers Engaged in the Manufacture of Hydroquinone. BAYES ANDERSON. *Arch. Ophth. Chlc.*, 1947, 38: 2

The author presents a survey on the incidence and severity of corneal and conjunctival pigmentation in workers engaged in the manufacture of hydroquinone. From these patients the author has reconstructed the sequence of events in this condition. After about 5 years of exposure to hydroquinone vapor a brownish tinge against the normally white sclera in the interpalpebral portion is noted. The conjunctiva in these areas appears slightly dried and to have a white, frothy foamlike deposit attached to it. The deeper portions of the conjunctiva acquire a light brownish sepia stain. The cornea remains clear.

After 2 or 3 more years the conjunctiva appears thicker and drier and small discrete dark brown to yellowish granules or globular precipitates are ob-

served in the deeper structures. Some migration of pigment from the limbus into the cornea can usually be observed at this time.

After a total of 5 or more years of exposure, the following picture is frequently found. Involvement is always limited to the interpalpebral zone of both the conjunctiva and the cornea. In the superficial layers of the conjunctiva fine glasslike spherules are found along the course of the superficial veins. Fine, discrete brownish granules in sizes up to one millimeter are noted, and extend down as deep as the basal epithelial cells where the larger granules are found. In the cornea just under or above Bowman's membrane are many fine grayish translucent and highly refractile dots. Vertical wrinkles are frequently found in Descemet's membrane. Two types of pigmentation are noted: (1) many fine dark brown to yellowish granules, and (2) a greenish-yellow homogeneous stain permeating the entire anterior layers of the cornea. Small scarred areas are seen lying beneath the epithelium. The cornea becomes roughened though it does not stain with fluorescein. The terminal nerve filaments appear enlarged and may account for the frequent hypesthesia.

It was found that the age of the individual and length of employment, correlated with the degree of exposure, was the most constant factor in determining the degree of injury. The prognosis is not good in that while conjunctival and corneal staining tend to disappear after a time, there is permanent scarring of the cornea and damage to vision. There seems to be no treatment other than prevention.

ROGER H. JORDON, M.D.

Treatment of Perforated Corneal Ulcer by Autoplastic Scleral Transplantation. SVEN LARSSON. *Brit. J. Ophth.*, 1948, 32: 54

Following the transcranial removal of a retrobulbar hemangioma in a 7 year old girl, a lagophthalmic corneal ulcer developed into a descemetocoele. Four attempts to close this lesion with a conjunctival flap were of no avail. Since the lesion was off center an opaque transplant could be used. Therefore a 2.5 millimeter scleral disc was removed from just below the external rectus muscle of the involved eye. The corneal defect was cleaned and enlarged and the scleral disc was fitted into the hole. A conjunctival flap was thrown over it. The disc healed in place and the final vision was comparatively good.

ROGER H. JORDON, M.D.

Solar Retinitis. EMANUEL ROSEN. *Brit. J. Ophth.* 1948, 32: 3

Various cases of solar retinitis as presented by other authors were reviewed. These patients had had a visual loss following looking into the sun or at a welding flash.

The author describes a patient who following prolonged gazing directly into the sun had had a considerable loss of vision in each eye. Fundus examination 6 weeks later showed each macula to have a peculiar greenish color with a pigment halo just

around the foveal reflex. Anterior to the foveal depression was a small, whitish-gray fluffy area. The picture was bilateral. The whitish areas disappeared in 10 days and the maculae became darkened. Five weeks later a definite hole had appeared in each macula. These holes were surrounded by a pigmented ring.

The author reported 23 cases with a macular hole or holes. All these patients had reduced vision and usually had a history of watching the sun directly but occasionally of watching reflected sun. He believes medical education for the prevention of these holes is important.

ROGER H. JOHNSON, M.D.

Surgical Treatment of Syphilitic Primary Atrophy of the Optic Nerves (Syphilitic Optochiasmatic Arachnoiditis): A Clinicoanatomic Study. WALTER L. BAUETSCH, *Arch. Ophth. Chic.* 1947 38 735.

The author discusses the propriety of surgical intervention in patients with primary syphilitic atrophy of the optic nerves due to syphilitic optochiasmatic arachnoiditis. The discussion is based on a histologic study of 12 cases.

Four patients presented no arachnoidal adhesions at all. In 2 cases some slight arachnoidal thickening was observed which was considered normal and 6 cases presented definite syphilitic arachnoiditis in the optochiasmatic region. Although grossly these 6 cases presented pronounced thickening of the arachnoid embracing the optic nerves the chiasm and at times the third and other cranial nerves. Microscopic examination revealed that the thickened arachnoid passed harmlessly over the optic nerves and chiasm without pressure on the optic nerves.

It is pointed out that primary syphilitic atrophy of the optic nerve is the result of an inflammatory process in the intracranial part of the optic nerve and chiasm which originates in a basilar syphilitic meningitis. Only in some cases is an optochiasmatic arachnoiditis produced.

It is concluded that surgical removal of the arachnoidal adhesions is of little if any benefit because the inflammatory process within the optic nerves and chiasm remains unaltered by the operative procedure.

The most efficacious treatment for this condition is malarial therapy aided by a course of concomitant and subsequent injections of penicillin—5,000,000 units in each course.

JOSEPH ZUCKERMAN, M.D.

EAR

Further Observations on Temporary Deafness following Exposure to Gunfire. G. REID, *J. Laryngol.* 1946, 61 609.

This report is a continuation of an earlier article on the same subject, but gives the results in greater detail than the first one.

It is stated that the experiments were carried out with a blank rifle cartridge fired a certain distance

from the patient's ear and that about 15 minutes after the test an audiogram was taken. The author gave the distances of the muzzle of the rifle from the subject and also the possible variables that might have been present in production of the noise.

It was found that the average hearing loss for each subject usually increased steadily as each round was fired until, with some subjects, further shots at the same intervals caused only slight further increase in deafness. The author showed that the noise usually effected one frequency and as further rounds were fired to the same subject other frequencies above and below were affected.

It was proved that some men are much more sensitive to the noise than others and that it is not possible to determine which subject is sensitive and which is not. There was no evidence that the size or shape of the external auditory canal or the position of the pinna relative to the head is of any importance in causing the variation of sensitivity from one subject to the other. One possibility is the presence or absence of a plug of cerumen which, when present, may cause less sensitivity.

It is shown in the discussion and by experimental proof that the sensitivity of a certain subject may vary according to whether or not he has had previous exposure to loud sound. The author gives briefly the possible reasons why the same individual may have less sensitivity to sound after repeated exposures.

The author shows that very rapid fire causes less deafness than a slow rate of fire and gives possible explanations for this. He shows that a moderately rapid rate of fire affects the frequencies of 4006 and above while the slow rate of fire seems to produce its main effect in the frequency range between 2048 and 4006 complete vibrations per second.

All gunfire, regardless of the type, affects mainly the high tones and the results depend upon the individual rather than the gun and there is no characteristic audiogram that can tell the type of noise which produces the deafness.

The time of recovery is shortest in the lowest frequency and longest in the highest frequencies. When the deafness is severe there is usually a lag of several hours before recovery begins in the upper frequency and occasionally the deafness increases after exposure before recovery begins. After recovery sets in its rate follows a roughly exponential curve. The last frequency to recover was usually either 9747 or between 4006 and 5793 c.p.s. Usually the patients with audiograms showing peak losses between 30 and 40 decibels recovered in 24 to 48 hours and those with losses of 20 decibels recovered in a few hours and sometimes within 1 hour. In the review of the recovery curves the impression was sometimes obtained that certain frequencies passed through a phase of hypersensitivity before settling down to the pre-exposure level.

The study of the recovery curve leads to the consideration of the mode of onset of permanent deafness. In the cases presented no serious permanent loss of hearing was produced by the exposure to the

noise. One patient, however showed a very slow recovery and about 8 months after exposure considered that his hearing had not returned. This particular patient had been exposed to seven exposures of the same or less severity during 13 days prior to the last exposure to the noise which seemed to bring on some permanent deafness. This seems to show that it is possible that one extremely severe exposure may result in permanent damage if the patient had also been exposed to previous loud sounds from which, however he had recovered.

The author presented a number of charts, graphs, and records of the cases.

WILLIAM A. ARBROW, M.D.

Some Observations on Bone Conduction following the Fenestration Operation. R. R. WOOD. *J. Laryng. Otol.* 1943, 63, 21.

From the beginning otosclerosis appears to produce a middle ear deafness for low tones and a mixed type of deafness for high tones. As the disease progresses, bone conduction is reduced for low tones also and nerve deafness gradually develops.

It is generally thought that the fenestration operation for otosclerosis has no effect on nerve deafness as measured by bone conduction. Six audiograms are presented from patients who have had the fenestration operation. In 5, the fenestra was open and bone conduction as well as air conduction was improved. The opposite ear was masked with an electrical buzzer, mounted in the ear piece and giving an intensity level 75 decibels above threshold. The average increase for air conduction in the 518, 1024, and 2048 frequencies in the operated ears for all 5 cases was 29.4 decibels. The average increase in masked bone conduction for the same ears was 14.3 decibels. In the remaining case the fenestra had closed, and hearing by both air and bone conduction had returned to the preoperative level. The increase in bone conduction which accompanies the increase in air conduction in the successfully fenestrated ear is presented as a clinical observation for which the explanation has not yet been determined.

JOHN R. LEONARD, M.D.

The Present Status of the Diagnosis and Treatment of Endolymphatic Hydrops (Ménière's Disease). HENRY L. WILLIAMS. *A. n. Otol. Rhinol.*, 1947 50: 6-4.

It would seem that a more accurately descriptive term for Ménière's disease would be endolymphatic hydrops. The term "Ménière's disease" because it has been connected with so many different pathologic entities, has become confusing and should be dropped. Ménière did not clearly distinguish between the symptoms of endolymphatic hydrops and positional nystagmus with vertigo, and furnished as a probable pathologic basis for the condition the report of a case which did not meet the clinical criteria for the diagnosis which he had established. There is confusion in the minds of many commentators in Ménière's disease or syndrome between

the terms *dizziness* or "giddiness" and *vertigo*. Some of the confusion in regard to the proper differential diagnosis between Ménière's disease and other conditions in which either vertigo or dizziness is present would be corrected by a more careful use of terms. The first step in the treatment of vertigo or dizziness is the proper interpretation of the patient's complaints. Without this, effective treatment is not possible. The terms *dizziness* and *giddiness* should be restricted to an abnormal sensation of unsteadiness characterized by a feeling of movement within the head without the sensation of the external world or the patient himself being in motion. *Dizziness* or *giddiness* as a subjective sensation should not be confused on the other hand with the sensation of unsteadiness associated with ataxia. At times true vertigo and dizziness can coexist.

In caloric testing, a functional test of diagnostic significance in endolymphatic hydrops, one is measuring the absorptive properties of the surrounding tissues for either hot or cold as well as the functional condition of the labyrinth. Even though it has been pointed out that in the caloric test one can compare the reactivity of one ear with that of the other there still seem to be too many uncontrolled variables in a caloric test to allow general conclusions to be drawn. The directional preponderance test, while superior to previous methods of testing would not seem to add much to a diagnosis obtained by a well taken history and tests of cochlear function. Fortunately much of the confusion and controversy in regard to Ménière's disease has been dissipated by the discovery of the true pathologic picture in authenticated cases of this disorder. In all cases reported, gross dilatation of the endolymphatic system, affecting chiefly the scala media (ductus cochlearis B.N.A.) and the sacculus and utricle, is present. Minor degenerative changes are found in the organ of Corti and at times in the stria vascularis. In all cases reported inflammatory changes have been conspicuously absent. This pathologic picture at once disposes of a vast group of disorders that have been termed "pseudo-Ménière's disease" in which the underlying condition is usually inflammation.

In the course of treating a large number of patients who had endolymphatic hydrops the concept that the cause of this condition is a form of physical allergy was formed. Although many previous observers had suspected this relationship a search of the literature yielded only a little direct evidence in its favor. Acceptance of the hypothesis that there are two physiologic mechanisms with similar clinical expressions, immunologic allergy and physical or intrinsic allergy, resolves nearly all the difficulties that have prevented the general acceptance of endolymphatic hydrops as a type of allergy. The gist of the concept, that endolymphatic hydrops is a form of physical or intrinsic allergy is that the inherited tendency of the endothelial cells of certain capillary loops to react abnormally to the alarming stimuli of Selye is the anatomic and physiologic basis of the group of conditions known as physical allergies with

their disturbance of water and electrolyte metabolism consequent to altered permeability of the cell membranes of the affected cells

At the Mayo Clinic 55 patients whose condition was diagnosed as the physical allergy syndrome underwent the Atkinson test and subsequently were treated with either histamine or nicotinic acid with regard to the results shown by the test. The following conclusions were drawn from these tests: (1) there does not seem to be any agreement between the results of skin testing with histamine and the results of treatment (2) skin tests with histamine seem valueless both for diagnosis and as a guide to therapy (3) these findings do not bear out Atkinson's contention that vasospastic and vasodilating types of allergy exist, since the response of all types in the physical allergy syndrome was equally good to treatment with either histamine or nicotinic acid.

From a review of the literature it would appear that Atkinson's hypothesis that there are two types of persons who have endolymphatic hydrops has little if any clinical or laboratory evidence to support it. The author points out that any capillary vasodilator—probably by virtue of its action in opening up the capillary loops involved and sweeping out their contained local excess of histamine to be dilated and metabolized in the body generally—will produce results comparable to those of any other

recurring attacks of either sudden falling or vertigo and nystagmus with loss of hearing and usually tinnitus in the affected ear differentiation should be confined at least to those conditions which tend to produce recurring attacks of vertigo. Conditions inflammatory basis are (1) trauma of the head with injury to the labyrinth or its tracts (2) multiple sclerosis (disseminated sclerosis) (3) intermittent tubal occlusion (4) positional nystagmus (5) Bruns syndrome (6) carotid sinus syndrome and (7) toxic vertigo

Successful medical treatment of endolymphatic hydrops has always been based either on the hypothesis that permeability of the capillaries of the stria vascularis was increased or on the hypothesis that cording to the author this is essentially the same as considering endolymphatic hydrops to be a form of physical allergy

At the Mayo Clinic we have found that atropine in large doses (up to 1/175 grain [0.00037 gm]) will have a tendency to control the acute attack of endolymphatic hydrops as well as few minimis of 1/1,000 of epinephrine given intravenously. From the review of medical treatment it may be seen that those measures have proved effective which were directed toward correction of the electrolyte balance in the tissue fluids toward control of the fluid metabolism or toward stimulation of the autonomic nervous system and the production of vigorous vasodilation. This clinical evidence all points toward the conclusion that endolymphatic hydrops is an

allergic phenomenon usually of the physical or intrinsic type.

Surgical treatment of endolymphatic hydrops includes labyrinthotomy and intracranial division of the eighth nerve. At the Mayo Clinic patients who had endolymphatic hydrops have undergone destructive labyrinthotomy and have been completely relieved of vertigo. From the nature of the two procedures labyrinthotomy should be more free from untoward complications than intracranial division of the eighth nerve.

The author believes that in the United States as in England labyrinthotomy is destined to replace intracranial division. The fact that approximately a fifth of the patients on whom hemisection of the nerve is done subsequently have hearing on the side on which the operation was performed is surprising in view of the fact that the pathologic process appears to have its major expression in the ductus cochlearis and the normal expectation would be continued progress toward complete loss of hearing in the involved ear despite preservation of the cochlear nerve. In the selection of patients for surgical treatment, however those in whom the hearing in the involved ear is still useful and those in whom it can be demonstrated that restoration of hearing to useful levels can be obtained by medical means should not be considered candidates for surgical treatment.

Transmastoid Atticotomy in Chronic Tympanomastoid Suppuration. A. TOMARKIN, *Proc. R. Soc. M. Lond.* 1947 40: 761

Convinced that radical mastoidectomy is not the answer in chronic tympanomastoid suppuration the author evolved the transmastoid atticotomy technique after seeing a reference to the work of Thies on the transmastoid route.

Under general anesthesia and weak adrenaline solution infiltration, an incision (Fig. 1) is made by means of a fine knife and a slotted antral speculum. It starts at Sharpnell's membrane ascends to the outer attic wall to the midline of the roof of the external auditory canal, and turns downward and outward at the osseous and cartilaginous junction of the canal defining an elliptical flap which is easily elevated. The whole bone of the outer attic wall and the postsuperior wall is clearly exposed. Fine laryngeal excise semilunar pieces of bone starting at the tympanic ring. The chiseling is done gently and outward until the aditus, the short process of the incus, the perfect orientation almost at once (Fig. 2). The extent of the operation is determined by the findings if necessary the whole mastoid process can be explored. The anterior pouch of the attic should be left till the last, the incudomalleolar articulation being exposed in order to determine the fate of the incus whether it is to be preserved or not, and the subsequent amputation of the head of the malleus. After the necessary toilet the skin flap is rolled into place and lapped over the facial ridge to cover the raw edges



Fig 1

Fig. 1 (Tumarkin) Transmental atticotomy. The incision. Note the granulations on the posterosuperior quadrant of the tympanic ring. The tympanic membrane in that region has collapsed on to the inner tympanic wall.



Fig 2

Fig. 2. Transmental atticotomy. The bone incision completed. Showing incus, semicircular canal, facial nerve, and stapes. A comparatively limited excision of bone. The exposure can easily be extended forward, upward, or backward. The strip of bone overlying the head of the malleus would normally be removed so as to gain access to Prussak's pouch.

right up to the semicircular canal then reflex penicillin is squirted in to fix the flap. The first dressing is done about a week later and consists merely of syringing the selex out. Frequently small granulations form in the roof at the site of the original incision which should be gently snared off under cocaine anesthesia. Usually the cavity heals in from 4 to 6 weeks.

The rationale of atticotomy is that in chronic otorrhea the disease is in the middle ear attic, and aditus and in the great majority of cases, there are no outlying cells which are diseased or otherwise. The process is hypoplastic and is of the ivory or diploetic type. In from 60 to 80 per cent of the cases, it yields to simple hygiene of the outer ear from which it may be deduced that there is little or no involvement of the bone and the disease is confined to the accessible soft tissue adjacent to the tympanic ring. Next to this benign condition is the intermediate stage which consists of slight caries of the tympanic ring or of the ossicles and perhaps, some accumulation of granulation tissue and debris in the aditus or antrum hence the operation of choice will commence at the tympanic ring and may be followed up if the disease is extensive. Intracranial complications are rather rare at present and timely atticotomy will abolish such complications and, at least, preserve if not improve the hearing by saving the incus.

Criticism of this operation are as follows (1) it is performed in a dark pool of blood (2) there is insufficient room for manipulation (3) it endangers

vital structures such as the stapes, facial nerve dura and lateral sinus (4) one cannot with certainty reach the limits of the disease and (5) the operation is difficult and demands meticulous care and precision.

Among the advantages are (1) it takes only from 30 to 40 minutes (2) no sutures or ligatures are required (3) the postoperative care is simple (4) healing is rapid (5) the atticotomy flap does not encroach on the wax-bearing area so that crusts do not accumulate and (6) at times it is possible to preserve the incus.

From 50 consecutive patients, 43 replies to the questionnaires were received. Thirty-eight of the patients were completely healed and the 4 remaining had no gross purulent discharge. In certain cases, there was a substantial improvement in hearing, although in no case was hearing on the side operated upon as good as on the opposite side.

A. B. VICENTIO M.D.

NOSE AND SINUSES

Osteomyelitis of the Basphenoid and Basocipit with Meningitis and Cranial Nerve Palsies as a Complication of Nasopharyngeal Packing for Control of Epistaxis: Report of a Case with Recovery. ARTHUR A. SPAR AND HENRY L. WILLIAMS. *Arch. Otolaryng. Chik.*, 1947 46: 473.

The authors report a case in which they call attention to the serious complications which may follow the use of nasopharyngeal packing for control

of epistaxis. In this instance abscess of the nasopharyngeal vault occurred and led to osteomyelitis of the basisphenoid and basiocciput meningitis and cranial nerve palsies. This is believed to be the first such case reported in which recovery occurred.

Sphenoid sinusitis almost always has been found to be the primary source of infection but the principles of extension of infection into the basisphenoid are equally applicable to infection originating on any surface of the body of the sphenoid. In this case the infection originated in the nasopharynx after trauma and stasis caused by prolonged nasopharyngeal packing. Trauma and infection of the nasopharyngeal mucosa probably led to thrombophlebitis of the vessels supplying this bone and osteomyelitis resulted.

The superior margin of the right choana well anterior to the adenoid region and inferior to the ostium of the sphenoid sinus was considered to have been the site of origin of the abscess. The size of the cavity in the basisphenoid was evidence that the overlying meninges must have been in close contact with the inflammatory process. Extension of the products of inflammation into the meninges in this region gave rise to the reactive meningitis. The possible presence of a nonunited metaphysis in the basisphenoid might have been an additional factor in the development of meningitis. Involvement of the medulla was assumed to have given rise to neurologic symptoms. Involvement of the masseter and pterygoid muscles was transient and was probably due to limitation of motion due to pain.

Though not apparent immediately in the critical period of the patient's illness a malignant lesion of the nasopharynx or of the sphenoid sinus with superimposed infection seemed a possible diagnosis so radium was used. Even though the lesion later proved to be nonmalignant the benefit of the use of radium in facilitating drainage became evident when the amount of pus coming from the nasopharynx increased noticeably within 24 hours after the use of radium.

Mucoceles of Frontal and Orbital Cells. H. BAUMWER AND L. SAVITT *Ann. Otol. Rhinol.* 1947 56 917

Mucoceles of the frontal and orbital ethmoid cells are not uncommon. The diagnosis is not difficult if the mucocele bulges into the nose or orbit. In those cases in which the extension is upward into the frontal sinus, the symptoms are not definite and even the roentgenogram often does not reveal the diagnosis.

Two cases are presented in which the operative findings were most likely that of ethmoid mucocele bulging into the frontal sinus. In the first case the posterior wall of the frontal sinus was extremely thin and bluish in color at time of surgery. After perforation of this plate a great amount of nonfetid pus escaped. This pus-containing pocket appeared to be a dilated ethmoid cell. The second patient was found during operation to have a frontal pyocoele. In addition, the floor of this dilated frontal sinus was entirely

membranous and thus membranous floor bulged into the sinus laterally. Further investigation proved this to be a cystlike sac filled with pus and lying between the frontal sinus mucosa and periorbit. In the first case a Lathrop-like sinus operation had been performed 16 years previously. Other investigators have noted that mucoceles may develop also following Gansen-Lynch and Killian operations.

JOHN R. LINDSAY, M.D.

Restoration of the Nose, Lip and Maxilla by Surgery and Prostheses. VARASTAD H. KAZANJIAN *Plast. Reconstr. Surg.* 1947 3 531

The combination of reparative surgery and maxillofacial prosthesis offers many advantages. Among other things the success of plastic surgery depends on restoration of contour particularly about the mouth and the maxilla. Without adequate support from within the mouth, satisfactory results in the contour of the lips and cheeks cannot be obtained. Prosthetic devices about the nose, orbit, and other parts of the face offer a more limited field generally when surgical methods are inadvisable or impractical.

A thorough and complete history of a patient in whom surgery and a prosthetic device were used to attain a satisfactory result, is presented. Numerous excellent pictures together with clear concise diagrams portray the various stages of surgical repair of the upper lip and a portion of the nose with the use of an intraoral nasopalatine prosthesis.

EARL H. KLASBUND, M.D.

MOUTH

Condylar Growth and Mandibular Deformities. MITCHELL B. ENGEL AND ALLEN G. BRODIE *Surgery* 1947 22 976

This report is an analysis of 19 cases of arrested growth in the mandibular condyles and their subsequent deformities. It is the purpose of the study to emphasize the importance of the development and function of the jaw in the condylar area.

Mandibular growth results from an integration of activities in numerous areas and thus arrest of growth in the condyles results in pronounced mandibular deformities.

The authors give a very brief description of the development of the mandible and include several photomicrographs of the normal developments.

The condylar development is maintained in activity until about the twentieth year and this growth results in the normal forward and downward vector for the mandibular growth as well as the increased width of the jaw.

Disturbances in the growth of the mandible may occur as a result of mastoiditis or middle ear infection, hematogenous infections, infections in dental areas, or from injuries resulting in fractures or in disturbances of the bone-forming cartilage. Also generalized arthritis involving the temporomandibular joint may result in arrest of the development.

Also in animals, endocrine disturbances have been found to be a cause.

A series of 19 cases with history of involvement of the condyle was studied. The injury of the condyle was determined on the basis of history, x ray studies of the area (cephalometric, laminagraphic, and routine temporomandibular films) and analysis of joint function.

In several instances it was possible to follow the same individual serially over periods ranging from 1 to 15 years. In 8 cases the involvement was bilateral. Unfortunately however the histories were incomplete in many cases. Many cases gave a history of growth arrest that was early or congenital in origin. Others revealed an association of infections with subsequent ankylosis, but significant functional impairment was not always present. Orthodontic treatment was attempted in 8 cases, and 6 patients had arthroplasties.

For purposes of comparison the tracings of the mandibles of the same individual were superimposed upon the anterior portion and lower mandibular border as regions of relative stability since apposition and remodeling are minimal in those areas. The authors describe other measurements made of the jaws in their cases.

The clinical findings showed that when there was unilateral involvement the unaffected side usually appeared flat and underdeveloped, while the arrested side of the face gave the impression of fullness. The mandible was skewed toward the side of the affected condyle. There was generally notching of the lower border or the ramus-body junction. The patient was frequently unable to deviate the jaw toward the normal side.

With bilateral arrest of growth there was usually a symmetrical type of deformity resulting in a *V gelenck* with a very retruded mandible and the chin lying in the hyoid region. Lateral function was not always possible and the antegonial notching was present bilaterally.

The authors give a description of the roentgenological findings in the cases of unilateral and bilateral involvement. The authors also give a discussion on the disturbance of growth in these cases and state that sometimes growth may slowly begin again even though there appears to be a stoppage of growth, and therefore surgery is contraindicated unless it is definitely shown that all growth has been stopped by repeated examination of the patient. Surgery is not contraindicated if the cartilage has been prematurely ossified or so badly scarred as to preclude further growth. In older individuals the possibility of additional growth of the jaw does not constitute a problem.

Some authors believe that muscle imbalance is a major factor involved in producing the dysplasia. In the author's opinion the validity of such an assumption is difficult to sustain because of the following findings:

1. Resections of either the condyle or horizontally through the superior portion of the ramus for the

correction of mandibular prognathism in older people did not result in any significant changes in the form of body of the mandible over a period of years.

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The efforts of the plastic surgeon together with those of the orthodontist are necessary to attain cosmetic improvement.

The authors include several photomicrographs of normal jaw development and photographs of several of their patients, as well as some roentgenograms. Some graphs are also included to show the relationship between normal and abnormal growth of the jaw.

WILLIAM A. ARKOOK, M.D.

PHARYNX

Ludwig's Angina—A Surgical Approach Based on Anatomical and Pathologic Criteria. *IVAR TORNBERG, Acta. Otol. Rhinol.* 1947 56: 937

Ludwig's angina begins as a cellulitis of the submandibular space. It attacks the fibrous tissue, fasciae and muscles but not the submandibular gland. It produces gangrene with a serosanguineous putrid infiltration, but usually there is little or no frank pus. Although many patients respond to chemotherapeutic and antibiotic drugs surgery is sometimes necessary. The goal of surgery is release of tension, and not a search for pus. The two structures chiefly responsible for this tension are the suprahyoid fascia and the mylohyoid muscle. Relief of tension is best achieved by dividing these structures at right angles to their fibers.

A transverse skin incision is made from a point one-half inch anterior to the angle of the mandible to a point beyond the midline. The underlying platysma muscle and suprahyoid fascia are cut transversely. The submental artery is ligated. The submaxillary gland is freed and retracted laterally. A grooved director is placed behind the mylohyoid muscle and its fibers are cut transversely. The mucous membrane of the floor of the mouth may be divided if tension is great. Section of the geniohyoid and digastric muscles and removal of the sub-

mandibular gland should be omitted. The same procedure may be necessary on the opposite side. Rubber drains are placed into the wound.

Asphyxiation is the most common cause of death. This may be due to obstruction of the air passages or to paralysis of the medullary respiratory center. Medullary paralysis can be caused by apnea as a result of persistent shallow rapid respiration or by hypersensitivity of the carotid sinus reflex due to the adjacent inflammatory process. Sudden death may be prevented if the following suggestions are heeded: (1) perform early tracheotomy when necessary (2) administer inhalation anesthesia only through a tracheotomy because introduction of a laryngoscope may induce fatal stimulation of the carotid sinus (3) manipulations in the regions of the carotid sinuses should be done only with the patient awake or under deep general anesthesia (4) local anesthesia is preferred.

JOHN R. LINDSAY, M.D.

Beta Hemolytic Streptococcus Parasitism in Infections of the Upper Respiratory Tract. NOAH FOX, *Arch. Otol. Rhin. 1947 46 703.*

The object of this study was to determine (1) the frequency of beta hemolytic streptococci in patients suffering from sore throat and (2) the response of these patients to local sulfathiazole therapy.

Although, generally speaking, these patients suffered from sore throat, they were readily divided into those who had acute exudative tonsillitis and pharyngitis and those who had nonexudative infection of the tonsils and the pharynx; the latter condition usually ushering in a general infection of the upper respiratory tract.

In this series of cases there seemed to be a definite relationship between streptococcal parasitism and the presence of tonsils or hyperplastic pharyngeal lymphoid elements. Patients with large masses of lymphoid tissue in the pharynx or with large tonsils definitely had greater bacterial counts of all organisms and were the sicker patients. Patients without tonsils and with little pharyngeal tissue were not so sick and were only infrequently harbors of beta hemolytic streptococci. Moreover their throats could be sterilized more rapidly.

Lymphoid tissue seems to supply the medium par excellence for growth of beta hemolytic streptococci, but the fact that these organisms have been recovered from the tonsils or from pharyngeal lymphoid tissue does not necessarily prove them to be the primary etiologic agent of disease. Beta hemolytic streptococci may be found in the throats of healthy persons. Hare found that on the average about 7 per cent of the normal population have these organisms in their throats.

One procedure available for the corroboration of a beta hemolytic streptococcus infection includes that of demonstrating antibodies during convalescence. This, however is too complicated for the ordinary office laboratory. Other procedures include determining the presence of an increase in the titer of anti streptolysin or antistreptolysin. Although the anti

streptolysin test is more highly specific, the antistreptolysin test is simple enough for routine clinical use. This test gives a positive reaction in about 80 per cent of cases of beta hemolytic streptococcus infection.

Throat culture studies were made of 400 patients suffering from sore throat. All had the sporadic types of sore throat seen in ordinary office practice. No epidemic conditions were included. In 64 patients unilateral or bilateral exudative tonsillitis or pharyngitis was present without any particular involvement of the pharyngeal mucosa except that covering lymphoid tissue. In 336 patients the soreness was due to a diffuse nonexudative inflammation of the pharyngeal lymphoid tissue and mucous membrane. The frequency with which beta hemolytic streptococci were isolated in the 64 cases of exudative tonsillitis and pharyngitis was 48 or 75 per cent, while the frequency in the 336 cases of nonexudative tonsillitis and pharyngitis was 24 or about 7 per cent.

Sulfathiazole is not as toxic as the other sulfonamide drugs and exerts an antibacterial effect on pneumococci and staphylococci, as well as on beta hemolytic streptococci. According to Pfeiffer and Holland, its bacteriostatic potency is twice that of other sulfonamide compounds.

In the procedure of treatment on which the present study was made, each of the two groups of patients classified on the basis of having exudative tonsillitis and nonexudative infections of the throat, respectively was divided into two numerically equal subgroups. In 32 of the patients who had exudative tonsillitis treatment consisted of having each chew a gum tablet containing 0.25 gm. of sulfathiazole for one hour repeating every other hour. The gum was chewed only during waking hours. Except for rest in bed no other local treatment was used. In the patients under this treatment any improvement noted must be credited to the local, rather than to the systemic, effect of the drug since previous experiments have shown that under similar conditions only a trace of sulfathiazole is found in the blood at the end of 12 hours. No other treatment was given except for the relief of pain.

The second subgroup of 32 patients with exudative tonsillitis was given a gargle consisting of warm saline solution. A glass of this solution was gargled every 2 hours. In addition these patients were placed on daily doses of 40 gr. (2.59 gm.) each of sodium salicylate and sodium bicarbonate. Patients with fever were put to bed.

The treatment instituted in the two numerically equal subgroups of the total of 336 patients with non-exudative tonsillitis was similar to that employed in the two subgroups of patients with exudative tonsillitis.

The average duration of clinical illness in the cases of exudative tonsillitis in which beta hemolytic streptococci were found was 3 days with sulfathiazole gum therapy while in those in which the salicylates were used the average duration was 3 days. In the cases of nonexudative tonsillitis in which sulfathia

Also in animals, endocrine disturbances have been found to be a cause.

A series of 19 cases with history of involvement of the condyle was studied. The injury of the condyle was determined on the basis of history, x-ray studies of the area (cephalometric, laminagraphic, and routine temporomandibular films) and analysis of joint function.

In several instances it was possible to follow the same individual serially over periods ranging from 1 to 15 years. In 8 cases the involvement was bilateral. Unfortunately however the histories were incomplete in many cases. Many cases gave a history of growth arrest that was early or congenital in origin. Others revealed an association of infections with subsequent ankylosis but significant functional impairment was not always present. Orthodontic treatment was attempted in 8 cases, and 6 patients had arthroplasties.

For purposes of comparison the tracings of the mandibles of the same individual were superimposed upon the anterior portion and lower mandibular border as regions of relative stability since apposition and remodeling are minimal in those areas. The authors describe other measurements made of the jaws in their cases.

The clinical findings showed that when there was unilateral involvement the unaffected side usually appeared flat and underdeveloped while the arrested side of the face gave the impression of fullness. The mandible was skewed toward the side of the affected condyle. There was generally notching of the lower border or the ramus-body junction. The patient was frequently unable to deviate the jaw toward the normal side.

With bilateral arrest of growth there was usually a symmetrical type of deformity resulting in a *V* shaped face with a very retruded mandible and the chin lying in the hyoid region. Lateral function was not always possible and the antegonial notching was present bilaterally.

The authors give a description of the roentgenological findings in the cases of unilateral and bilateral involvement. The authors also give a discussion on the disturbance of growth in these cases and state that sometimes growth may slowly begin again even though there appears to be a stoppage of growth, and therefore surgery is contraindicated unless it is definitely shown that all growth has been stopped by repeated examination of the patient. Surgery is not contraindicated if the cartilage has been prematurely ossified or so badly scarred as to preclude further growth. In old individuals the possibility of additional growth of the jaw does not constitute a problem.

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WILLIAM A. ANDREWS, M.D.

PHARYNX

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Ludwig's angina begins as a cellulitis of the submandibular space. It attacks the fibrous tissue fasciae and muscles but not the submandibular gland. It produces gangrene with a serosanguineous putrid infiltration, but usually there is little or no frank pus. Although many patients respond to chemotherapeutic and antibiotic drugs, surgery is sometimes necessary. The goal of surgery is release of tension, and not a search for pus. The two structures chiefly responsible for this tension are the suprahyoid fascia and the mylohyoid muscle. Relief of tension is best achieved by dividing these structures at right angles to their fibers.

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ment. In this manner the patients receive the quick action of Lugol's solution and the sustained action of propylthiouracil until the full control of hyperthyroidism is obtained. Iodine therapy therefore aids in the early clinical improvement and also reduces the vascularity of the thyroid gland for thyroidectomy. The slowing effect on the recovery due to the Lugol's solution is outweighed by the rapid clinical improvements. Patients with adenomatous goiter do not require iodine and a days of treatment are required for each percentage of elevation of the basal metabolic rate.

In the last 4 years 830 patients have been prepared for thyroidectomy with antithyroid drugs. Thiouracil was used 381 times, thiobarbital 28 and propylthiouracil 421 times. There was an operative mortality of 0.12 per cent as compared with 1.49 per cent prior to the preoperative use of these drugs. Two-stage operations have been reduced from 16 per cent to practically nil. As a result of experience proper preparation of the hyperthyroid patient with antithyroid drugs followed by thyroidectomy offers the best chance of restoration to health in the shortest period of time with minimal risk. The recurrence rate after 2 years in patients treated preoperatively with antithyroid drugs, is 2 per cent. 1 per cent required reoperation and 1 per cent obtained full control after a daily dose of Lugol's solution.

In the author's hands, thyroidectomy and the proper treatment resulted in cure in 95 per cent of his cases. The toxicity incidence of thiouracil is 9 per cent and that of propylthiouracil is 1.6 per cent.
 RICHARD J. BENNETT, JR., M.D.

The Clinical Significance of Examination of the Supraclavicular Lymph Nodes in Carcinoma
 (Ueber die klinische Bedeutung der Untersuchung der supraclavikulären Lymphknoten beim Krebs)
 ELMAR JAKOBSON *Acta chir scand* 1947 96 75

The frequency of occurrence of Virchow's gland in association with carcinoma of various organs was investigated. Supraclavicular metastases were noted on the left side in 129 of 914 cases of carcinoma originating in various organs (14.1 per cent). The incidence of supraclavicular metastases in carcinomas of the various organs was as follows: breast 21 per cent, prostate 18 per cent, liver and bile ducts 17 per cent, lung 16 per cent, stomach 14 per cent, ovary and uterus, 13 per cent, pancreas 12 per cent, intestines 8 per cent, and esophagus, 7 per cent. Since microscopic examination of the supraclavicular glands was done only in the doubtful cases (about 50 per cent) the figures given are based on macroscopic

diagnosis. The supraclavicular metastases varied in size from that of a pea to that of an orange. It is believed that metastases to the supraclavicular nodes is retrograde from the thoracic duct because of the proximity of the junction of the thoracic duct, the internal jugular vein and the efferent channels of the supraclavicular nodes. Variations in intrathoracic pressure and in venous pressure, particularly with forced expiration, could cause reflux of lymph laden with carcinoma cells into the efferent channels of the supraclavicular nodes.

In the entire series there were only 3 cases with bilateral supraclavicular metastases, the site of primary growth being the stomach, the lung and the liver in one instance each. Theories concerning the mode of spread to the right and left supraclavicular nodes are presented. Statistics of various investigators in the literature show that supraclavicular metastases occur much more frequently in association with carcinoma of the lung than with carcinoma of the stomach. Several authors attribute this to the fact that the lymph channels are much shorter in the former. Cases of prostatic carcinoma and of genital carcinoma in the female have been reported in which the first clinical symptom has been enlargement of the supraclavicular lymph nodes. A study of the age distribution of supraclavicular metastases showed the highest incidence to be in the younger age group.

JOHN L. LUNDQVIST, M.D.

The Mechanism of Phonation after Laryngectomy
 (Sobre el mecanismo de la fonación esofágica después de la laringectomía) ROBERTO C. FERRARI
Bol Acad argent cir 1947 31 693.

Esophageal phonation is today the only acceptable recourse to speech after laryngectomy. The efficiency of esophageal phonation depends upon three factors: (1) the degree of strength that is required; (2) the possibility of continuous speech for a certain length of time without fatigue and with enough intensity; and (3) the character of rhythm, tone and pitch resembling a laryngeal voice.

The mechanism of esophageal phonation depends upon two factors: (1) the intake of air into the esophagus and (2) the expulsion of this air to produce sound as it passes two mucosal folds which the author believes to be the main vibratory element (although other authors believe the cricopharyngeal muscle as most important in phonation).

With the use of the esophagoscope and roentgenogram, the author has observed the dilatation of the esophagus in its transverse diameter resembling a megacolon.

ARTHUR F. CROLLA, M.D.

zole gum was used, the average length of illness was 3 days and in those in which salicylates were used it was also 3 days.

JOHN F. DELPER, M.D.

NECK

Neoplastic Disease of the Thyroid Gland. JOHN C. McCLENNOCK and GUSTAVUS H. KLINCK, Jr. *West J Surg* 1948, 56: 52.

The authors review 331 cases now listed in the Cancer Registry of the American Association for the Study of Golter. The purpose of this Registry is to establish pathologic criteria for the recognition of malignant disease of the thyroid gland and also a generally acceptable classification.

The authors separate neoplasms of the thyroid gland into three major groups for the purpose of study. These include a group of definitely benign tumors a group of clearly malignant tumors, and (the largest group) a group containing all tumors in which the differential diagnosis between benignancy and malignancy is extremely difficult.

Neoplasms which are clearly malignant can easily be recognized by their departure from normal thyroid architecture which is characterized by a lack of differentiation and anaplasia by the presence of mitoses, and by evidence of local invasion or distant metastases. This group includes such types as large cell small cell, and epidermoid carcinomas, and according to many authors, the sarcomas. All cases of the large cell type of carcinoma or epidermoid carcinoma which were followed up for 3 years terminated fatally. Thirty five of these were in the Registry and all of the patients lived less than 15 months. In contrast, the life expectancy in small cell carcinoma is better as 3 patients lived 18 months and 1 died after 7 years from a cause other than the thyroid cancer. It seems likely that some of these may in reality be lymphoblastomas which respond to surgery and radiation therapy. The spindle form of large cell carcinoma caused early death.

Blood vessel invasion and capsule invasion are the most reliable criteria for the diagnosis of malignancy in the borderline groups. In 23 of 66 cases of adenocarcinoma, the diagnosis was based upon capsule invasion alone, with 2 deaths and two five year survivals to date. Blood vessel invasion was the sole diagnostic criterion in 7 cases. 4 of the patients are dead 2 dying of diseases other than thyroid cancer 3 survived 5 or more years. In 27 patients the diagnosis was established by the demonstration of both blood vessel and capsule invasion. Nine of these patients are dead and 9 have survived for 5 years. One patient is alive 27 years after the first diagnosis of cancer. In 9 cases the only criterion was invasion of the adjacent thyroid tissue. There have been 4 five-year survivals, but no deaths in this group.

In 36 of the papillary adenocarcinoma group of 60 cases, the diagnosis was based upon capsule invasion alone, with 5 deaths and 7 five-year survivals. Blood vessel invasion alone was the criterion in 7 cases, with 3 deaths and 3 five year survivals to date. Both

of these criteria were found in only 11 patients of whom 2 are dead and 2 have lived 5 or more years. Adjacent thyroid tissue was invaded in 6 cases with 1 death and 1 five-year survival to date. Capsule invasion alone is perhaps the most important diagnostic criterion in the papillary adenocarcinoma group.

The authors believe that several types of adenocarcinoma will ultimately be recognized. Among these are the so-called fetal type, the embryonal type, and the so-called Huerthle cell type.

ERNEST D. BLOOMENTHAL, M.D.

Thiouracil and Allied Drugs in Hyperthyroidism. EMER C. BARTLE. *N England J M* 1948, 38: 6.

As a result of the use of antithyroid substances in the treatment of hyperthyroidism there is a fall in the basal metabolic rate and a gradual amelioration of all hyperthyroid signs and symptoms except those of the eye. The antithyroid substance is active by preventing the synthesis of iodine to an active protein-bound hormone. Thiouracil was given in a daily dose of 600 mgm. Propylthiouracil, the drug now being used, is administered in a dosage of 500 mgm. a day. Thiobarbital had the highest incidence of complications, 18 per cent thiouracil, 9 per cent and propylthiouracil 1.6 per cent.

The use of antithyroid drugs as a means of treatment has certain specific disadvantages, and although the hyperthyroidism can be adequately controlled for a prolonged period it entails periodic observations or understanding of antithyroid therapy on the part of the physician or the patient.

Certain objections to this treatment include failure to bring about cure of the hyperthyroidism, the persistence of golter the inherent danger of not removing adenomatous golters, the possible reaction to the medication, and the possible development of serious histopathological change in the thyroid gland. The possibility of reaction to medication, although small is real, and past experience has shown there is no time during which one can feel entirely safe with its administration.

The chief use of the antithyroid drugs as reported in this article has been in preparing patients for thyroidectomy. When the treatment with these drugs is carefully managed subtotal thyroidectomy can be carried out without risk, and hyperthyroid reactions during anesthesia and after operation which in the past have caused great concern, are completely eliminated. Patients with milder hyperthyroidism, however are still prepared with Lugol's solution alone. These drugs are used until the full benefit is obtained, which is indicated by complete relief of all hyperthyroid signs and symptoms and return of the basal metabolic rate to nearly normal. Furthermore, it is advisable to keep patients at a normal metabolic level for a month or more before proceeding with thyroidectomy.

These patients now receive propylthiouracil and iodine simultaneously from the beginning of treat-

lanes in the membrane encapsulating the hematoma. Putnam found true 'giant capillaries' in the dural wall of the hematomas such as are nowhere else observed in the body. It stands to reason that repeated secondary hemorrhage may occur easily from these extremely dilated capillaries. This assumption is also supported by the observation that the erythrocytes in old subdural hematomas more than 2 months after the injury, looked well conserved and were hardly discernible from fresh blood.

The treatment of subdural hematoma is opening and evacuation of the sac.

THE PATHOGENESIS OF CONTROUPOUR INJURIES OF THE BRAIN

It is a well known fact that blunt traumas of the skull, as a rule, cause far more severe injuries of the brain on the side opposite the impact. The explanation usually given is that the brain hits the opposite wall of the skull by transmission of force. The author attempts to refute this theory. He discusses in detail the laws of mechanics involved in this problem and reports a great number of ingenious experiments done by himself, his collaborators and other men to study the effect of blows on a hard shell (bone iron) enclosing an incompressible substance with the physical properties of brain tissue. He tries to prove that the so-called contrecoup injuries are caused by the 'flying off' (Abschleuderung) of brain tissue at the pole opposite the injury rather than by the impact against the bony wall. To illustrate this phenomenon he quotes the well known eye injuries of blacksmiths when a blacksmith hits by mistake the steel anvil instead of the softer iron steel splinters flung off from the opposite end of the hammer head may cause perforation of the cornea and lens. The most interesting of his many experiments which seems to prove his point was this: half of a brain was enclosed in an iron tube which was open at one end and had a thick rounded bottom at the other. A hammer blow to the bottom caused the brain substance to fly off at the opposite pole. WERNER M. SOLMITE, M.D.

SPINAL CORD AND ITS COVERINGS

Cervicobrachial Neuralgia and Rupture of the Cervical Discs (Neuralgie cervico-brachiale et rupture des disques cervicaux) A. RICARD, P. F. GIRAUD, A. GARDI, and R. BRITTE. *Lyon. chir.*, 1947 42 513.

The primary object of this article is to draw the attention of the medical profession in France to the syndrome of the herniated disc in the cervical region. Naturally the literature on this subject from America has been extensively used, and in view of the fact that the subject itself has been clearly defined only since the outbreak of the war this article is most appropos. Communications with France and with the medical profession in that country have been established only recently. The reason for this preamble is that in the United States the subject dealt with so acceptably in this article is already on a firm footing in the minds of the physicians and surgeons here.

The authors' study is based on 10 cases of herniated cervical disc, 4 patients were operated upon and 6 were not. The case histories of the patients are presented along with the roentgenographic studies and operative findings. Various questions pertaining to the clinical examination are discussed and the statements of known American surgeons are quoted. The authors did not use lipiodol in their studies and believed that the lateral views of the cervical spine were of sufficient localizing value. Two of their patients, however, presented themselves because of pain in the face. The question of differential diagnosis is discussed, especially in regard to the syndrome of the scalenus anterior muscle. Contrary to opinion in the United States, the authors do not believe that vasomotor disturbance variations in the blood pressure or paresthesia on the ulnar side of the hand are characteristic of the scalenus syndrome.

Because of the operative procedure employed absolute localization was not essential. The authors' operation is a laminectomy of the fifth and sixth cervical vertebrae with intradural inspection of the offending disc. When the disc is found one of three alternatives is adopted: section of the posterior root over the disc, simple decompression or incision of the disc on the anterior surface of the cord with curettage of the disc. The last is seldom used. Localized arachnoiditis has been observed and is considered responsible for some of the neurological symptoms. The technique of the operation is described. It includes general anesthesia and the sitting position. ADRIEN VAN BROOKEW, M.D.

SYMPATHETIC NERVES

Surgical Therapy of Bronchial Asthma (Sulla terapia chirurgica dell'asma bronchiale) GERLANDO MARRA. *CHIRURG. ANN. ITAL. CHIR.* 1947 24, 447.

After having reviewed the different methods suggested and tried by different operators in the surgical therapy of bronchial asthma, the author refers to his results in 15 cases of severe asthma in which the patients were treated by means of an anesthetic block.

For the cases of bronchial asthma in which medical therapy fails the author advocates bilateral injections of alcohol into the stellate ganglion with extension to the superior cervical, and down to the second thoracic ganglion. The procedure may be repeated until optimum results are obtained.

This treatment should be preferred to operative intervention, because the latter is inaccurate and carries a surgical risk. ARTHUR F. CROILLA, M.D.

MISCELLANEOUS

Abdominal Visceral Sensation in Man BRONSON S. RAY and CHARLES L. NEILL. *Ann. Surg.* 1947 126 709.

The present study on abdominal visceral sensation in man was carried out on a series of patients, most

SURGERY OF THE NERVOUS SYSTEM

BRAIN AND ITS COVERINGS CRANIAL NERVES

Blunt Injuries of the Skull and Brain (Ueber stumpfe Schadel- und Gehirntraumen) K. LEWYGERAUBER.
Hdvt. chir. abh., 1947 14: 543.

The author at the Surgical Hospital of the University of Bern, Switzerland, discusses three important factors with regard to blunt injuries of the skull and brain: (1) the mechanism of cerebral concussion (2) the subdural hematoma and (3) the pathogenesis of contrecoup injuries of the brain.

CEREBRAL CONCUSSION

It is a well established fact that not all major injuries of the brain are accompanied by loss of consciousness. According to a German article on shot injuries of the brain during the last war, more than 50 per cent of gunshot wounds did not bring about symptoms of concussion. Even destruction or severance of large parts of the cortex may occur without loss of consciousness. However, any blunt force hitting the skull vertically to its surface may induce concussion. It seems that involvement of the brain stem is necessary to bring about the typical symptoms.

Among the various theories which have been submitted to explain the mechanism of concussion, the author favors the old 'molecular' theory which assumes that the momentary increase of intracranial pressure causes minute molecular changes in the incompressible brain substance and brings about a transient 'stupor' of the cells in the brain stem. The author tried to support this theory by interesting experiments with fish which were exposed to explosions under water. He believes that these experiments refute the theories which consider edema of the brain or sudden pressure of the liquor against the fourth ventricle as the cause of concussion.

As to treatment of concussion, it is not advisable to do a spinal puncture unless critical symptoms develop. Just as we use pressure bandages in the treatment of frozen limbs to prevent the secondary edema, it is preferable from the therapeutic point of view to leave a certain degree of increased intracranial pressure as the counterpressure of the unelastic skull will check the development of brain edema. If however, spinal tap is necessary, the liquor should be drained very slowly and reinjected if the symptoms get worse as there is always the danger of herniation of the brain into the foramen magnum.

The author rejects intravenous injection of hypertonic solutions in the attempt to lower the intracranial pressure. The increase of blood volume leads to increased blood flow to the brain and, therefore, counterbalances the lowering effect of the hypertonic solution. In 6 patients, the spinal pressure was measured before, during, and after intravenous in-

jection of 200 c.c. of 20 per cent glucose. No lowering effect on the pressure was established in any case. Researches published by Wepl and Koenig, collaborators of the author, showed that isotonic and hypertonic solutions, when injected intravenously are eliminated from the circulation up to 50 per cent within 40 minutes and entirely after 2 or 3 hours.

Lyophilic serum (dried serum dissolved in a fourth of the original volume of water) is applied in quantities of from 50 to 100 c.c. and seems to be able to attract tissue fluid and so to lower the intracranial pressure. On the other hand it, too, increases the blood volume and, therefore, counteracts the lowering effect on the spinal pressure.

The application of magnesium sulfate by mouth or rectum (from 5 to 10 gm. t.i.d., or 50 gm. rectally in 100 c.c. of water) seems to be more effective than the intravenous osmotherapy.

SUBDURAL HEMATOMA

This condition is caused by rupture of the veins which course from the superior longitudinal sinus across the arachnoidal space. Most cases are of traumatic origin, although alcoholism or other pathological processes may cause rupture of the vessels without trauma. Wear and tear and chronic overstraining of these thin walled veins may lead to damage of the intima with secondary thrombosis and thus bring about subdural hemorrhage.

Diagnosis of subdural hematoma is a difficult problem because in the majority of cases symptoms do not develop immediately but after from 8 to 14 days, sometimes even after many weeks. The explanation given at present by most surgeons is that, due to the proximity of the cerebrospinal liquor the volume of the hematoma increases gradually by osmosis after the original source of hemorrhage has stopped. Experiments with blood enclosed in a cellophane bag and suspended in saline solution seem to support this theory.

Furthermore, as the blood in the hematoma sac is gradually broken down by hemolysis to molecules of smaller volume, the osmotic pressure is increased and more tissue fluid is attracted.

The author discusses a number of arguments against this theory of osmosis. He rather believes that the delayed development of symptoms like headache and somnolence is caused by the toxic action of autolyzed blood. He showed that sterile autolyzed human blood injected intradermally produces intense urticarial reactions and also some general symptoms. It is likely that histamine-like substances are formed by autolysis of blood whenever primary resorption of a hematoma is slow for some reason or other as in hemorrhages into the peritoneal cavity in a cyst of the thyroid, or in hemorrhagic periorchitis. These toxic substances originating in autolyzed blood cause extreme dilatation of the capil-

CHEST WALL AND BREAST

Phlebitis of the Anterolateral Thoracic Wall,
Mondor's disease (Phlébite en cordon de la paroi
antéro-latérale du thorax. Maladie de Mondor)
LUCIEN LÉGER. *Presse méd.*, 1947 55 849.

The author discusses an interesting syndrome seen in 22 patients. It is described as phlebitis of the thoracic wall noted most often in adult females between the ages of 25 and 55. The lesion is a cordlike band adherent to the skin and subcutaneous tissue with retraction resulting in an orange peel appearance in some areas. The structure occurs usually in the lower anterolateral chest region most often on the left side. The cord seldom is less than from 20 to 30 cm. in length and its diameter measures from 2 to 3 mm. Its consistency has been variously described as fibrous, indurated or cartilaginous. Its terminations gradually blend into the adjacent tissue, or two or more divergent strands may spread out from its lower most portion over the abdominal wall. In 3 cases double cords were noted along the left anterior axillary line.

This so-called thoracic wall phlebitis has an insidious onset. There frequently is pain, occasionally increased in severity by deep breathing. In some instances the linear cord is apparent only when the arm is widely abducted. There is no adenopathy and no abnormalities of the breasts have ever been noted. Roentgen films of the chest are normal and there is usually a leucocytosis with both monocytosis and eosinophilia. Bacteriological studies have been negative.

Histologically the lesions have the appearance of small veins and lymph vessels manifesting subacute obliterative endophlebitis associated with a certain degree of thrombosis. The vascular tissue in many areas is replaced by dense fibrous tissue. It has been postulated that the thoracoepigastric vein, the long superficial vein of the anterolateral thoracic wall, might be the anatomical basis for the lesion.

Benignity is the rule. The lesion persists for many years, one case having been followed for 8 years. Most patients are but little disturbed physically but in some the lesion is painful and in these cases extirpation is indicated. In those with marked cancerophobia, surgery is likewise justified.

OSVILLE F. GRIMES, M.D.

Amputation Versus Transposition of Gland and Nipple in Mammoplasty J. W. MALINZAC.
Plast Reconstr Surg 1948, 3 37

Essential requirements for the repair of a breast deformity are (1) injury to the gland and galactophorus ducts should be avoided or kept to a minimum in order that mammary function be preserved (2) the main blood supply to the breast must be preserved, particularly where extensive resection of hy-



Fig. 1 (Lucien Léger)

pertrophied tissues is involved in order to prevent necrosis of the skin and glandular structures (3) the resulting shape of the breast must be harmonious in all dimensions, and (4) scars should be slight and adequately concealed.

The procedure of amputation with excision of the nipple and its free transplantation to a new site according to the methods of Darligues or Thorek violates most of these premises, and is indicated only in huge hypertrophies with pronounced stasis. Even in many of the latter cases a less crippling procedure with preservation of the nipple can be successfully employed.

Following free transplantation of the nipple, no continuity of its ducts is restored. Physiologically the author states, this is tantamount to necrosis of both nipples. Normal sensitivity and contractility are absent or greatly reduced, and the mammary functions of the breast are lost—an important point particularly in unmarried girls and women who have not yet born children. Even with a complete 'take of the freely grafted nipple, a flattened configuration of the breast results from the use of a horizontal flap and the sacrifice of most of the glandular elements. In those rare cases of extreme enlargement, in which transposition would require too extensive incision, a one stage subtotal mastectomy can be done by removing the excess breast tissue from the posterior surface of the gland and excising the superfluous skin and fat along the midline and the submammary fold. The nipple itself is not disturbed and remains attached to the galactophorus system. In the occasional case of huge enlargement with edema and stasis of

of whom had hypertensive cardiovascular disease and all of whom were subjected to thoracolumbar sympathectomy in which the paravertebral ganglionated chain was resected from the seventh thoracic through the third lumbar ganglia, and the splanchnics were resected from the celiac ganglia to a point above the contribution of the seventh thoracic ramus. In certain studies additional interruption of nerve pathways supplemented the standard sympathectomy. Observations were made on the pain sensitivity of the stomach, large and small intestine, biliary tree, pancreas, and urinary tract prior to denervation, and at various times up to a year after right or left sympathectomy and after bilateral sympathectomy. All of the results reported were observed more than once and in some cases many times, and while it is realized that additional observations are desirable, the findings seem adequate at least for a preliminary report.

The small and large bowel was studied by balloon distention with a rubber bag attached to the end of a Miller Abbott tube. Varying volumes of air were used to induce painful stimuli. Illustrative diagrams are presented showing the areas of sensory reference.

Thermal stimulation was carried out by distending the balloon with warm (from 110 to 120°F) and cold (32°F) water. Direct stimulation of the stomach and intestinal tract through celiotomy was carried out on 6 patients who had previously had unilateral or bilateral sympathectomy. Tests of pain sensitivity were also carried out on the biliary tract, pancreas, and upper urinary tract.

Studies of visceral sensation before and after sympathectomy in which the splanchnics and ganglionated chains are removed from the seventh thoracic to the third lumbar ganglia on one or both sides show the following:

1. Pain sense in the stomach, intestine (except the rectum), extrahepatic biliary tract, pancreas, kidney

and ureter is mediated wholly by visceral afferent nerves which accompany sympathetic nerves within the area of the operative excision.

2. The kidney and ureter and the two sides of the colon have a homolateral sensory supply, but the remaining organs with the possible exception of the gastric mesentery have a bilateral supply.

3. Pain sensitivity exists not in the walls of the stomach and intestine but in the proximal mesenteries and at the mesenterovisceral juncture.

4. Adequate stimuli for pain include distention of the hollow viscera, traction and faradic stimulation of the stomach and intestinal mesenteries, and manipulation, traction, faradic stimulation of the extrahepatic biliary tract, pancreas, kidney pedicle, and ureter.

5. There is perception for extremes of temperature in the stomach; the afferent pathway accompanies the sympathetic.

6. The urinary bladder has a triple sensory supply via the visceral afferent nerves of the sympathetic and sacral parasympathetic systems and the somatic pudendal nerves.

7. Interruption of appropriate sympathetic nerves may be employed for the relief of intractable pain associated with some types of abdominal visceral disease.

8. The extensively sympathectomized patient may undergo certain alterations in his response to visceral disease because of the loss of visceral pain sense. So far none of the several hundred sympathectomized patients of the authors series have been known to develop acute appendicitis, cholecystitis, or any other abdominal surgical disease. However it is now the authors' practice to perform cholecystography on most patients who are to undergo sympathectomy for hypertension, if gallstones are discovered cholecystectomy is advised unless otherwise contraindicated.

HOWARD H. LAMER, M.D.

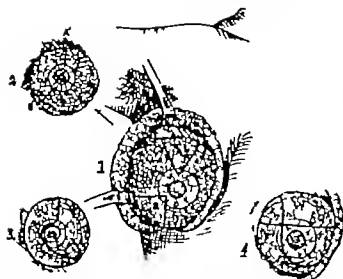


Fig 2 Safe and harmful glandular resections. 1. A, B, safe areas for wedge-shaped resection in the upper and lower lateral quadrants avoiding injury to the main vascular pedicles of the lateral thoracic and internal mammary arteries. 2. A, B' closure of glandular defects in safe areas and mastopexy to the pectoral fascia. (Affirmation of the gland is done at present along the posterior aspect of the breast.) 3. F, external resection of gland with upward rotation of an internal glandular pedicle—unsafe procedure (Gillies). 4. E, E' resection of upper half of the gland. F' extensive external resection (Biesenberger). These procedures are contraindicated because of the sacrifice of the main blood supply of the gland and possibility of necrosis.

main role in the vascularization of the gland and nipple. It follows that since in no individual case can the type of blood supply be foreseen the technique of choice of mammoplasty is one which preserves the blood supply in all types of vascular distribution. Notably unsound procedures are those in which the lateral or superior portions of the breast are resected since the lateral thoracic artery may be sufficiently compromised to lead to necrosis.

A two stage mammoplasty with transposition of the nipple as shown in figure 1 is advocated by the author as the safest procedure and one assuring an esthetic result.

One hundred and forty two cases with but a single instance of necrosis of the nipple postoperatively are reported by one author and Malinac has reported a further series of 103 patients with large hypertrophies none of which subsequently developed total necrosis of the nipple.

One disadvantage to the two stage procedure as originally described is a resultant excessive width of the breast. To remedy this difficulty the author has regularly done a wedge-shaped resection of the glandular elements at the second stage with the simultaneous removal of surplus skin through an incision extending from nipple to submammary fold as shown in figures 2 and 3.

In contrast to the effects of amputation lactation is always possible following the transposition procedure.



Fig 3 Nipple sutured in the upper pole of skin defect. S lateral flaps are shaped along the midline and submammary fold, m m. 2. Final reversed T-shaped suture line.

sure. Nipple sensitivity recurs postoperatively in 80 per cent of patients in from 3 to 6 months. In 20 per cent of the patients, the diminished nipple sensitivity following operation varies with the amount of glandular excision. WAYNE T. CAMERON, M.D.

Cystic Mastitis and Cancer of the Breast (Mastitis quística y cáncer de mama) ALEJANDRO J. PAVLOVSKY and ISIDORO M. CÁCERES BRATODANO. *Bol. Acad. argent. cir.* 1947 31: 909.

The importance of recognizing malignant lesions of the breast before the appearance of axillary metastases or other signs of advanced disease is reaffirmed. The alleged benign character of cystic changes in the breast is looked upon as giving false assurance. In young women presenting bilateral involvement by small cysts, a benign process can reasonably be accepted and corresponding treatment given. The same bilateral involvement by enlarging cysts, however, when the menopause is approaching should be looked upon with suspicion and indicates histologic study. Solitary cysts occurring unilaterally and, particularly of large size in women about 40 years of age should call to mind immediately the possibility of malignancy or preneoplastic change. Histologic examination followed by appropriate treatment is in order under these circumstances. Other more indirect methods such as the cytologic study of aspirated fluid may be misleading. Histologic study should be directed particularly to that part of the cyst wall in contact with the gland.

In the authors series of 111 breast cancers 12 or 10.8 per cent were cases of malignancy occurring in association with cystic mastitis. Most of them were found in women between 30 and 50 years of age. The authors' opinions are supported by 4 case reports and by photographs of the gross and microscopic features of the specimen presented.

HIRSH T. LANGSTON, M.D.

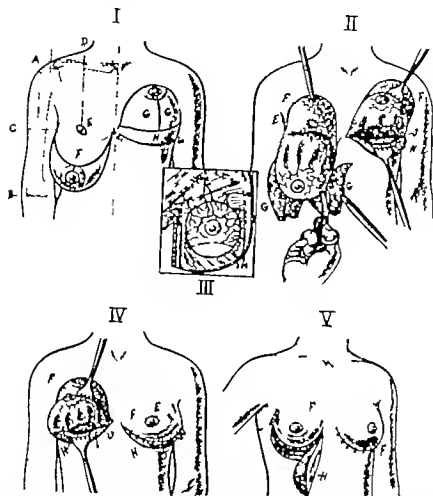


Fig. (Makins) Author's method I for the two-stage repair of hypertrophied breasts by a horizontal flap.

I st stage—Determination of new location of nipple. Horizontal lines are drawn across the clavicle (A) through the elbow joint (B) and half-way between A and B. Vertical line D is drawn through the middle of the clavicle. The intersection of lines C and D at E, determines the new location of the nipple. Outlining of anterior horizontal flap F, the lower border of which extends to the areola. G, excises skin on posterior and lateral aspects of breast to be excised. H, area of skin above submammary fold (a-a, b-b) to be preserved. I, first stage. II Shows denodation of the gland, excisions of lateral flaps (G) and removal of fat and glandular tissue from the lower pole (J). The illustration also shows superficial paring of fat and glandular tissue away from the nipple which since has been abandoned. N I that the vascular plexus around the reduced areola is retained also the thickness of the horizontal flap lined by

subcutaneous fat. III. Shows early concept of the blood supply in the breast. The lateral thoracic (T.L.) and external mammary (E.M.) branches of the axillary (AXL.) sending perforating branches to the external portion of the gland. Internal mammary (I.M.) and its perforating branches penetrating the inner half of the breast, (a) main perforating artery through the second intercostal space. For new concept of blood supply, see figs. 7, 8 and 9. IV Right breast shows closing of glandular defect following fixation of breast to pectoral fascia. Left breast shows nipple sutured in its new location, E, and skin flaps H and F loosely approximated and drained in place. V, 2nd stage. Right breast shows crescent-shaped excision of excessive skin, fat and glandular tissue along submammary fold. The hypertrophied structures can be in this stage freely excised without danger of impairing the vitality of the nipple. Left breast—final condition following closure of defect.

the nipple amputation is indicated by skin plasty and tattooing an artificial nipple can be created.

For the past several decades an erroneous conception of the blood supply of the breast (reprinted from one textbook to another) has led to complications subsequent to mammoplasty especially in cases of large hypertrophy in which extensive resection was

required. Anatomically it has been established that the blood supply of the breast derives from two vascular pedicles originating from the lateral thoracic and internal mammary arteries. In 55 per cent of all cases the lateral thoracic artery has an equal importance to the internal mammary artery and in 13 per cent the lateral thoracic artery has predomi-

decortication of the lung in 3 cases of tuberculosis complicated by chronic empyema.

In 2 of the cases, the results were very good. In the third although the result of the decortication was disappointing, the procedure was carried out with out any difficulty and the patient suffered no damage as a result of the operation. The cavity had been reduced to one-half of its previous size so that radical thoracoplasty was more effective.

The technique employed is described in detail
SAMUEL KARN, M.D.

Pleuropulmonary Manifestations of Amebiasis.
HIRAM T. LANGSTON AND ROBERT T. FOX. *Arch. Surg.*, 1947 55 618.

The authors present in brief a review of 10 cases of pleuropulmonary amebiasis seen over a period of one year.

All of these patients were veterans, but some of the men had not seen service in geographical areas of high infestation. These cases illustrate the fact that such conditions can clearly mimic any of the commoner forms of pleural, pulmonary, or other disease and since the amebae may be very difficult to demonstrate in the discharges, anti amebic therapy is frequently indicated on suspicion. The response to such therapy is specific and furnishes a diagnosis as well as treatment. Aspiration is used to relieve symptoms and hasten healing, but surgical drainage is not considered necessary as a rule as it is likely to prolong convalescence if improperly exhibited.

Six case histories and 4 illustrative roentgenograms are appended
HIRAM T. LANGSTON, M.D.

ESOPHAGUS AND MEDIASTINUM

Esophageal Stenoses Due to Caustics (Esterosis cáusticas del esófago). AUGUSTO LATOURE AODRE.
Rev. de Medicina 1947 7 81.

Reviewing the general features of cicatricial stenoses of the esophagus, the author points out that most of them occur as a result of ingesting the offending agent during periods of alcoholic intoxication. The most frequent caustics are commercial hydrochloric acid and alkalis. The symptomatology can generally be divided into two periods. The first occurs immediately after the ingestion of the agent and is characterized by vomiting (frequently containing blood), a general picture of acute poisoning accompanied by fever, headache and difficulty in swallowing with pain and burning. This lasts usually for a week if the dose has not been excessive. The symptoms abate as a rule, thereafter and the second phase of the symptom picture appears toward the end of the third week, this being the stenotic phase.

The pathology in the digestive tract includes the changes in the mouth, pharynx, and larynx, which may range from superficial burning to deep ulceration. A similar picture is noted in the esophagus, and its severity again is dependent upon the potency of the agent, ranging anywhere from superficial ulcers

to actual perforation of the esophageal wall. Sloughs of the esophagus may be expelled and more or less extensive areas of ulceration persist. The author points out that lesions of the stomach are probably more frequent than is usually supposed.

The diagnosis is usually based of course on the history in the acute stages, but the location of the more important lesions requires x ray study with contrast media. The author calls attention to the fact that spillage of the barium into the air passages is frequently due to incompetency of the glottis rather than to actual tracheoesophageal fistulas. In the earlier stages before cicatricial stenosis has occurred the barium may pass readily but leaves the irregular pattern characteristic of mucosal ulceration.

The treatment in the early acute phase is concerned with maintenance of nutrition, relief of symptoms and the management of any complicating features. The author does not use gastrostomy with out due deliberation. Maintenance of the esophageal caliber is carried out by instrumentation beginning relatively early even on the fourth and fifth days. This is done in order to prevent reductions in the esophageal lumen rather than to wait for their appearance and subsequent correction. An esophageal lumen of 7 or 8 mm in diameter is believed adequate. If the patient is seen after the development of stenotic lesions dilatations by bogies, blind or under esophagoscopy control, are carried out. If gastrostomy has been performed retrograde dilatations may likewise be undertaken. A certain amount of technical detail concerned with the dilatations is given. The intractable stenoses are referred for corrective surgery.

The complications of course, include the immediate toxicity of the acute phase, the possibility of pyloric stenoses occurring as a result of gastric lesions and those complications which result from mediastinitis caused by perforation of the esophagus. The point is made that the cicatricial area is not apt to perforate on instrumentation but that perforations occur in a more normal adjacent portion of the esophageal wall. Another complication which may or may not be the result of instrumentation is the occlusion of the esophagus, total or subtotal which may require emergency management if spontaneous relief does not occur. The general picture of suppurative mediastinitis is described and allusion to its satisfactory management by the use of antibiotics is made.

Brief data on 41 patients with esophageal stenosis who were seen during the past 4 years are given. There were 23 males and 18 females. There were only 3 children. Of the 41 patients 19 were treated by the author from the beginning while 22 of them arrived late for treatment. There were 3 deaths in the first group and 8 in the second. The incidence of pulmonary tuberculosis is suggested as being relatively high in these patients.

The article is accompanied by several brief case abstracts and illustrative roentgenograms.

HIRAM T. LANGSTON, M.D.

TRACHEA, LUNGS, AND PLEURA

Pulmonary Arteriovenous Aneurysm. WILLIAM LAW
Watson Surgery 947 9-9.

The literature contains reports of only 10 cases of congenital or nontraumatic pulmonary arteriovenous aneurysms. Since the lesion consists of a lobulated thin walled, branching blood filled, pulsating pulmonary sac of varying size made up of both an arterial and a venous component, it seems reasonable to call it a pulmonary arteriovenous aneurysm, in order to distinguish it from benign hemangioma of the lung, metastatic pulmonary hemangioma of the lung, and hemangioendothelioma of the lung.

The diagnosis is suggested by a syndrome characterized by cyanosis, clubbing of the fingers and toes, secondary polycythemia, and symptoms of anoxemia, usually in a young patient with an obscure lung tumor and a normal heart. A bruit may be heard over the tumor.

It seems certain that trauma does not play an important part in the etiology as a history of injury was recorded in only one case. It must be assumed that a gradual expansive enlargement and thinning out of the walls of the vascular tumor takes place slowly over a period of years, and that spontaneous hemorrhage occurs when overextension increases the pulmonary pressure enough to cause a break.

Pulmonary arteriovenous aneurysms are congenital and mechanical defects in the relationship between the pulmonary arteries and veins, and as such are not amenable to medical therapy; they can be relieved promptly and dramatically by adequate surgical extirpation of the involved portion of the lung. There has been no reported operative mortality and the postoperative lung function studies indicate a return to normal factors.

Before operation there is marked hyperventilation at rest during moderate exercise and on recovery from exercise. The arterial oxygen unsaturation found at rest increases during moderate exercise. After operation, the high hematocrit and red blood cell volume decreases to normal and the arterial oxygen saturation improves.

Two additional cases are reported.

SAMUEL KAHN, M.D.

Cavernostomy. E. J. O'BRIEN, P. V. O'ROURKE, F. C. TERRY and E. F. SKINNER. *J. Thorac. Surg.* 947 6 602.

When the usual measures of collapse therapy are ineffective for cavity closure, cavernostomy is often used successfully for residual cavities after thoracoplasty. In 6 of 11 patients with such cavities, the condition was apparently arrested, the cavity closed, the wound healed, and the sputum became negative for tubercle bacilli. In another patient the condition was improved, the sputum became negative, the wound was reduced to a small sinus, and the cavity closed or was not definitely visible.

After unsuccessful trial of the usual procedures of collapse therapy cavernostomy is usually effective

in closing lower lobe cavities in patients with adequate cardiorespiratory reserve. In 5 of 6 such patients, the condition was apparently arrested.

Cavernostomy may be a useful procedure for patients without dyspnea or progressive tuberculosis when reduced function of the opposite lung prohibits collapse therapy or pulmonary resection. Open cavity drainage produced apparent arrest of the condition in 33 per cent, and improvement in 27 per cent of 15 patients in this group. In patients with obvious dyspnea or progressive tuberculosis, cavernostomy yields few good results. In 36 such patients, the operation was followed by apparent arrest of the condition in 3 per cent and by improvement in 14 per cent.

Healing of the wound and the cavity appeared to be most prompt when cavernostomy was preceded or accompanied by some surgical collapse of the involved pulmonary tissue. Most of the deaths and serious complications occurred in patients who had poorly resented advancing tuberculosis, or who were visibly short of breath prior to the cavernostomy.

SAMUEL KAHN, M.D.

Carcinoma of Cavities of the Lung. Its Evaluation and Importance for the Physician. (Des Kavernarkarzinom. Seine Bedeutung fuer den Arzt und fuer die Begutachtung.) SEYMOUR GRANT.
Dtsch. med. Wochschr. 1947 73 405.

Carcinomas may develop as primary tumors in the wall of a tuberculous cavity in the lung. Their occurrence is not extremely rare, but is apt to be overlooked in many cases. No case has ever been diagnosed intra vitam. Even in autopsies, the diagnosis can be missed easily as it is difficult to differentiate the tumor from the surrounding necrotic and caseous tissue. In all observed cases, the tumor originated from the border area between the bronchus and the wall of the cavity. It may cause metastases to the regional lymph nodes, the kidneys, liver, brain, thyroid and bones. Microscopically, the tumor reveals the picture of a squamous-celled epithelial carcinoma.

The author reports 6 cases observed at the Pathology Institute of the General Hospital Barmbeck in Hamburg Wandsbeck. All cases occurred in men between 43 and 63 years of age.

The role of tuberculosis as the causative factor and the medicolegal problems connected with it are discussed.

WILHELM M. SCHMIDT, M.D.

Decortication in Chronic Empyema of Tuberculous Origin. FRANK B. GORD. *J. Thorac. Surg.* 947 6 587.

In view of the relative frequency with which chronic empyema complicates pulmonary tuberculosis, the unsatisfactory results obtained by methods of treatment other than decortication (including extrapleural thoracoplasty and operations of the Schede type) and the crippling deformity which follows in those who survive extensive operations for collapse of the chest wall the author performed

The esophageal cysts however often lie close to or within the wall of the esophagus. Thus attempts to excise these cysts involve a risk or injury to the esophagus and dangerous complications. The intrathoracic enterocystomas occur for the most part on the right of the midline.

Symptoms from these mediastinal enterocysts can be traced to (1) direct mechanical pressure of the cyst on neighboring organs such as the blood vessels, heart, esophagus, trachea, and bronchi and (2) complications which rapidly increase the volume of the cyst, such as infection or hemorrhage. The diagnosis is easy to make for it is generally made after complications have developed and led to a thorough examination of the thorax, particularly with the roentgen ray. There are cases however in which the diagnosis has been made after an incidental roentgen examination.

The method of treatment is operation not only in the case of acute complications during the first few months of life but also in every case in which the development of complications or incidental or routine roentgen examination shows that a mediastinal formation is probably or undoubtedly present. The best approach to the field of operation in most cases is that used for pneumonectomy.

STEPHEN A. ZEEMAN, M.D.

MISCELLANEOUS

The Treatment of Thoracogastric Fistula G. E. LINDSKOG AND E. A. LAWRENCE. *J Thorac Surg* 1947 16 477

A fistula between the stomach and the left pleural cavity or chest wall may develop spontaneously as the result of perforation in a peptic ulcer or cancer either when the stomach is in normal intra-abdominal position or more frequently when the stomach is herniated into the thoracic cavity. A thoracogastric fistula may also develop acutely as a complication of wounds involving the diaphragm and stomach. Rarely a thoracogastric fistula results from ill-advised surgical intervention when the existence of a diaphragmatic hernia with incarcerated stomach or eventration is not recognized and the surgeon at fault performs an intercostal trocar-catheter drainage under the misapprehension that a pleural effusion or empyema exists. The authors present 3 cases of this last type.

The first case was that of a 30 year old man who had been injured in an automobile accident 6 years previously. He had a fracture of the pelvis and of a left rib. Because of fluid in left pleural cavity with probable empyema a catheter was inserted and a dissecting infection of the chest wall subsequently resulted. When the drainage had stopped the catheter was removed and the chest wall healed. Five years later he developed left sided pain. Physical examination and roentgen ray studies revealed an opaque area pushing the heart to the right. Operation disclosed that the pleural cavity contained the stomach, left side of the colon and many loops of small bowel.

On reducing the viscous a defect in the central portion of the diaphragm was seen extending into the esophageal hiatus.

The second case was that of a 26 year old man who was also in an automobile accident, and who sustained injury to the left side of his chest. Blood accumulated in the chest which was removed by thoracentesis and intercostal catheter. Five months later he became ill. The catheter was still in the chest. The left lung was almost totally collapsed, the mediastinum was shifted to the right, and the transverse colon was displaced to the right. Barium by mouth appeared rapidly in the pleural cavity. At operation the stomach and part of the colon was seen through a diaphragmatic defect and reduced. Closure of the diaphragm was effected with silk sutures.

It is considered timely to report these experiences now because diaphragmatic hernia is a well recognized albeit uncommon complication of military and civil trauma. It should be recognized that blunt trauma to the chest and upper abdomen or a squeezing type of injury may by indirect bursting violence to the diaphragm particularly on the relatively unprotected left side, cause a laceration to appear in the thin central portion sometimes extending into a normal hiatus, commonly the esophageal hiatus. Such lesions are easily overlooked in the period of acute reaction to trauma because of surgical shock, the existence of other more obvious external trauma, or the presence of an obscuring hemothorax on the affected side. It should be emphasized that such a diaphragmatic rupture can occur in the absence of fractured ribs.

STEPHEN A. ZEEMAN, M.D.

Pulmonary Edema: Experimental Observations on Dogs following Acute Peripheral Blood Loss. ROBERT M. EATON. *J Thorac Surg.*, 1947 16 668.

Acute hemorrhage of 25 per cent of blood volume from the femoral artery of dogs has resulted in the following circulatory and pulmonary changes:

1. A temporary imbalance in the circulatory system in which there is an elevation of pulmonary artery pressure and peripheral venous pressure with no comparable elevation in the low systemic arterial pressure which follows acute hemorrhage.

2. A block to normal circulation within the lung which is acute for an hour or more and partially effective for several days.

3. A predictable pattern of pulmonary moisture change within a four hour period following hemorrhage, characterized by (a) an initial rise in pulmonary moisture during the first 30 minutes, associated with a drop in the plasma protein level and an elevation of the hematocrit reading (b) a drop at 45 minutes to levels below normal pulmonary moisture while the plasma protein level continues low and the hematocrit reading is slightly elevated (c) a second rise in pulmonary moisture above normal averages at 1 1/4 hours with plasma protein findings at their lowest and the hematocrit reading above normal (d) a leveling off toward normal pulmonary moisture at 4 hours with the plasma protein level low.

Esophageal Stricture following Agranulocytosis Due to Sulfonamide Therapy BURTON D. BRYAN. *N. England J. M.* 947:237-94.

Sulfonamide therapy carries with it the threat of depression of the centers of blood formation with resulting agranulocytosis, and thus of agranulocytic angina. Should the process that sets up this angina extend to the esophagus, acute esophagitis results.

A case of marked esophageal stenosis following agranulocytosis due to sulfonamide therapy is reported. It is assumed that the same process that caused the severe angina of the mouth also caused ulcers in the esophagus, and that after the acute esophagitis had resolved secondary cicatricial stenosis took place.

Had the nature of the esophageal lesion been appreciated sooner, bougienage at an earlier date might have prevented the resulting stenosis.

SAMUEL KAHN, M.D.

Gastrogenous Mediastinal Cyst. LOUIS R. DAVIDSON AND LOWELL BROWN. *J. Thorac. Surg.* 947:6-458.

This is the twenty-second case of gastrogenic mediastinal cyst recorded in the literature. The cyst was found during the course of a routine physical examination of a 5½ year old girl.

Examination at this time showed a well developed girl who was somewhat underweight. The only abnormal findings appeared to be dullness and diminished breath and voice sounds over the right lower lobe posteriorly.

At operation a large cyst of the posterior mediastinum measuring approximately 9 cm. in diameter was found. It extended from the third rib superiorly to about an inch above the diaphragm inferiorly, and was closely adherent to the posterior aspect of the upper half of the lower lobe posteriorly. The cyst was purposely tapped and its thin opalescent, light, coral-colored fluid was aspirated. It was then excised by blunt and sharp dissection. Inferiorly it appeared to be attached to the right side of the esophagus in close proximity to the diaphragm.

The postoperative course was entirely uneventful and the patient was discharged on the twenty first postoperative day. The final checkup roentgenograph showed the lung completely re-expanded.

An analysis of the 22 cases is given in table form. It is seen that these cysts have occurred primarily in infants and young children. One patient was 23 years of age and another 15 years; the rest of the patients whose cases are recorded have been under 5½ years of age at the onset of their symptoms or at the time of operation. Fourteen of the patients were males as against 7 females.

The location of the cysts has been remarkably constant. In 18 of the 21 patients the cyst was located in the right hemithorax, and in 17 patients it has been definitely located posteriorly.

Diagnosis remains an extremely difficult task. There is no symptom or symptom complex which is pathognomonic, several cases having been practically asymptomatic.

Aspiration has been used as a diagnostic as well as a therapeutic procedure. Fifteen of the 21 patients were submitted to operation and 9 of these recovered. Four of those recovering were treated by a stage operation with marsupialization and 4 by primary excision. There seems to be no question that operation is advisable in all cases, both because the exact type of tumor to be dealt with is usually not definitely known preoperatively and because these tumors almost always cause symptoms quite early in life. The high mortality is not surprising. Many of the patients are infants in extremely poor shape, and in these cases a stage operation with marsupialization of the cyst has in the past sometimes seemed most wise. With modern advances in the preparation of patients for operation, and with improved techniques for the administration of anesthesia, a one stage removal of the tumor will almost always be the procedure of choice.

The experience of Ladd should be kept in mind when attempting excision of these cysts. In one of his cases, a gastrogenous cyst shared a common muscular wall with the esophagus. Complete excision of the cyst resulted in an esophagopleural fistula with subsequent fatality. STEPHEN A. ZIEGLER, M.D.

Mediastinal Enterocystoma. NELS LINDBQVIST AND HELEN B. WOLFF. *J. Thorac. Surg.* 1947:16-468.

Mediastinal cysts of the enterocystoma type with mature gastric mucosa are most rare. The author reports the case of an infant 7 months of age, in whom the cyst was found when roentgen examination was made to determine whether or not the child had bronchopneumonia. Following recovery from the acute chest condition, operation was performed and a tumor the size of the entire upper part of the right pleural cavity apically and mediastinally, was removed. Recovery was complete in 2 weeks time.

Cystic formations of congenital origin (enterocystomas) occurring at different places along the alimentary tract and nearly always immediately adjoining it, are not particularly uncommon. They are lined with the various forms of mucous membrane occurring in different locations in the alimentary tract. The type of mucous membrane lining a cyst need not correspond with the part of the alimentary tract in which the cyst is situated, or with which it is intimately connected. It is also interesting from a surgical standpoint, that the muscular layers coating the cyst are often adherent to and sometimes comprise an integral part (microscopically) of the muscularis mucosae of the alimentary tract. As a rule, the cysts are well delimited from the actual lumen of the digestive tract. Sometimes, however, there is a direct communication. It is because of these two alternatives that the cyst sometimes contains the same matter as the alimentary tract and at other times contains a nonspecific watery fluid or fluid containing hydrochloric acid and pepsin.

The commonest situation for intrathoracic enterocyst mas is in the posterior mediastinum, often in fairly intimate contact with the pulmonary hilus.

SURGERY OF THE ABDOMEN

GASTROINTESTINAL TRACT

Contribution to the Knowledge of the Surgical Forms of Gastric Tuberculosis (Contributo alla conoscenza delle forme chirurgiche della tubercolosi gastrica) RAFFAELI NICOLÒ. *Gior ital chir* 1947 3 446

Tuberculosis of the stomach is relatively rare, but rarer still is its so-called surgical form and also its high localization as the literature consists mainly of pyloric and juxtapiyoric cases. Therefore, Nicolò reports a case of ulcerocicatrical type in which the lesion was located on the lesser curvature 6 or 7 cm. below the cardia in a man of 52 who had already been subjected to gastroenterostomy. The intervention consisted of removal of the lesion by saddle resection and longitudinal suture of the lesser curvature after verification of the integrity of the previous gastroenterostomy. Koch's bacilli and typical tubercles were demonstrated in the removed specimen.

The hematologic route and spread by contiguity seem to be the most frequent pathogenic mechanisms of the disorder. In the present case roentgen examination revealed signs of an old pulmonary lesion but no lesion in other localizations and it was thought that in all probability the gastric infection had occurred by the hematologic route. Anatomopathologically the lesion belonged to a mixed form the ulceroinfiltrative, because of the presence of great loss of substance and of intense proliferative and fibrous phenomena in the serosa. In this connection it is interesting to compare peptic with tuberculous ulcer keeping in mind that microscopic examination alone will lead to the correct diagnosis. While peptic ulcer decreases in size as it passes from the mucosa to the muscularis and the serosa, tuberculous ulcer has a larger diameter deeper down than at the mucosa and resembles a reversed funnel because the submucosa is more involved than the mucosa thus the borders of the tuberculous ulcer are usually undermined sometimes ragged and reddish, but rarely hemorrhagic.

The diagnostic criteria of tuberculous ulcer are very relative as the symptomatology of peptic ulcer is found in some cases and that of carcinoma in others. Of some importance would be an evening temperature the coexistence of tuberculous lesions in other organs and the presence of an epigastric tumor without any other characteristics of carcinoma, including age of the patient, as gastric tuberculosis is more frequent in the young. However all of these data may be absent as in the present cases in which the symptoms were those of typical peptic ulcer while objective examination and anamnesis revealed no trace of tuberculosis in other organs. The diagnosis of gastric tuberculosis is therefore nearly always retrospective. The roentgenogram is

of no help because in most cases it shows only signs that are hard to differentiate from those of carcinoma, and from those of peptic ulcer in a few cases.

Resection would seem to be the best intervention because the coexistence of gastric tuberculous and blastoma (carcinoma sarcoma, or lymphosarcoma) is not rare. However in the present case local and general considerations suggested limitation of the intervention to ample excision of the infiltrated and ulcerated tract after liberation of the adhesions to the pancreas. Excision is followed by longitudinal suture of the defect. Two years later the patient was found to be in excellent health and without any gastric disturbances.

RICHARD KEMEL, M.D.

Acute Perforation of Gastric Carcinoma (Sulla perforazione acuta del cancro gastrico in peritoneo libero) GIOVANNI FORNI. *Arch. Ital. mal. app. dig.*, 1948, 14: 54.

Perforation of a gastric carcinoma in the peritoneal cavity is not exceptional but merits more consideration. It is found most frequently in men (87%) between the ages of 50 and 60 years. Some of the factors are as follows: (1) general—age and sex (2) local—the type of tumor and (3) the determining factor—rapid distention of the stomach. The perforation is almost always single and is most frequently present on the anterior surface of the antrum.

The diagnosis should take into consideration the age and general condition of the patient and the symptomatology.

Resection is the treatment of choice giving the lowest mortality rate.

The prognosis is always grave and the mortality is high.

ARTHUR F. CIPOLLA, M.D.

Irradiation of Gastric Cancer G. CRANSTON FAIRCHILD and ALAN SHORTER. *Brit. J. Radiol.*, 1947 20 511

The authors have combined the surgical and radiologic approaches to the treatment of cancer of the stomach. Irradiation is administered with the abdomen open and directed to the cancerous tissue. Biopsy specimens are taken to help confirm the diagnosis. An accurate and effective dose of radiation at high intensity is given directly to the tumor and field of local spread without irradiation of the large volume of normal tissue including the vital organs and skin which is unavoidable when irradiating from the skin surface. This is of importance in an already anemic and cachectic patient. Operations to relieve obstruction, if necessary, can be performed before the irradiation at the same or an earlier and less extensive laparotomy. Although the obstruction may not be severe it increases because of fibrosis of the tumor following irradiation. Irradiation of normal viscera is avoided as far as possible by displacement and packing of the field. A special sterilized appli-

and the hematocrit reading above normal expectancy.

4. Recent histopathologic studies suggest that in some animals this adjustment of fluid economy after hemorrhage is temporary. Pulmonary edema has been observed histologically 5 days after blood loss during which there has been normal activity.

5. An aggravation of the pulmonary edema of acute peripheral hemorrhage results from the intravenous use of either physiologic sodium chloride, whole blood, or plasma. When physiologic sodium chloride is administered the increase in pulmonary moisture is twice that found when either whole blood or plasma are used following similar blood loss. Plasma protein levels drop when physiologic sodium chloride is used, while these levels are maintained fairly well when whole blood or plasma are given.

6. An increase in pulmonary transudation is noted by a marked stimulation to pulmonary lymph flow.

7. Histopathologic lung changes of edema, congestion, and hemorrhage are evident as soon as from 10 to 30 minutes after blood loss, and have been noted to persist for several days.

8. The pulmonary edema resulting from acute peripheral blood loss is a stagnant alveolar accumulation of high protein value. This may be an ideal culture media for droplet implantation from the nose and throat and for the subsequent development of pneumonia.

JOHN J. MALONEY M.D.

The Use of Fluorescein to Demonstrate the Effect of Artificial Respiration upon the Circulation.
SAMUEL ALCOTT THOMPSON, EURY LANCX, AND
EDWARD EDWIN ROCKEY. *J. Thorac. Surg.* 1947
6: 710.

Inflation and deflation of the lungs in a previously heparinized animal immediately after death produces a movement of the blood column within the vascular system. This can be observed by the intravascular injection of a tracer substance, fluorescein which gives a typical luminous appearance when examined under an ultraviolet light. The movement of the blood is in a normal direction and as such can be circulated over the entire body. This movement of the blood takes place without the benefit of any cardiac activity.

The widest and quickest distribution of the dye occurred when alternating positive and negative pressure resuscitation was used.

The importance of heparin in resuscitation is demonstrated. Heparin keeps the blood in a fluid state and as such allows it to be circulated. Once clotting has occurred no further circulatory movement is possible and all resuscitative attempts will fail.

Resuscitation with alternating positive and negative pressures is superior to resuscitation with either positive pressure or negative pressure alone.

JOHN J. MALONEY M.D.

terminate the first seroserosal suture. There should be no tension at the duodenal level and in particular not of the mesoduodenum. The duodenum is liberated and the gastroduodenal ligament repaired. Recently the authors have infiltrated the mesoduodenum with novocaine. The abdomen is closed over a drain in the subhepatic region which is removed on the tenth day.

The objection to the Péan anastomosis that it does not permit a sufficiently extensive gastrectomy is not justifiable. The gastrectomy should be made as extensive as indicated without regard to the type of anastomosis.

The present series of 100 patients included 80 males and 20 females ranging from 33 to 65 years of age, with the greatest frequency between 40 and 50 years. There were 75 with gastric ulcers including 16 of the lesser curvature at the gastric angle, 37 in the middle of the vertical portion, 7 of the posterior deciduity, 2 of the posterior surface and 3 in the juxtapyloric region. In 8 cases the ulcer spread to the pancreas and was associated with middle gastric stenosis in 2 cases and with pyloric stenosis in 1 case. There were 6 duodenal ulcers, 10 double ulcers of the lesser curvature and duodenum, 4 pyloric ulcers, and 3 jejunal ulcers following gastroenterostomy. There was 1 case of massive recurring gastrohemorrhage.

The postoperative complications of the Péan anastomosis seem less numerous than those following the Finsterer operation. They included 8 pulmonary complications (one bilateral and fatal), 1 case of pleurisy, 1 case of pulmonary embolism on the fifth day with recovery, 3 cases of watery or black vomitus with fetid regurgitations requiring gastric lavage.

Of the 5 deaths, only 3 could be attributed to the operation, autopsy revealing partial necrosis in the duodenal wound. In one of these cases the suture came in contact with the curetted base of the ulcer. In one case death occurred from intractable hemorrhage in spite of multiple transfusions. The Péan operation is not suitable for cases in which hemorrhage has caused vascular hypotension. The fifth death occurred in a woman of 65 years with bilateral pulmonary complications.

It is suggested that death from peritonitis might be avoided by more careful selection of patients and rigid observation of the requisite anatomic conditions. Four of the deaths occurred in the earlier period of the authors' experience. In desperate cases, dehiscence might be forestalled by suppression of all fluid nourishment, continuous aspiration of the fistula combined with immediate jejunostomy and abundant subsequent parenteral rehydration.

At present the indication of choice for the Péan anastomosis is ulcer of the lesser curvature. However ulcers of the surfaces, in particular the posterior surface, respond nicely to this technique if they are not too high up.

The Péan anastomosis is contraindicated in ulcer of the duodenum, gastric cancer, fulminating ulcers of the posterior surface externalizing into the pancreas, badly infected ulcers or recently healed per-

forations. In cases of profuse hemorrhage and anemia the Finsterer or Polya operation would seem preferable.

While the immediate advantages of the Péan procedure as described here appear not too striking the authors hope in a future publication to show that the end results justify the added risk involved.

EDITH SCHWARTZ MOORE.

Psychosomatic Considerations in Peptic Ulcer

MANUEL D. ZAMER, *Psychosomatic M.*, 1947 9 372

A punched out defect, the size of a quarter on the lesser curvature of the stomach or adjacent duodenum is a real thing objectively to the roentgenologist or gastroenterologist, and subjectively to the patient because of the writhing pain. This is a situation which the authors believe has been brought about by an underlying conflict in which the individual feels compelled to function in a certain manner despite anticipation of failure. As indolent peptic ulcers are created by conflict situations chronic as well as acute ulcers heal rapidly when the conflict situation is removed.

The peptic ulcer conflict situation involves both fear and resentment, each of which has opposing effects on the stomach and duodenum. When fear and resentment are experienced simultaneously the reactions in the stomach are dissociated and often result in increased acid motility and vascularity with decreased mucus. It is postulated that during such dissociation other protective substances and mechanisms are likewise deficient in the presence of increased acid and pepsin. Such physiologic concomitants to this conflict situation are highly conducive to the development of ulceration.

The ulcer diathesis resides in the basic character structure which readily thrusts the patient into the peptic-ulcer type of conflict situation. If this situation is of short duration the symptoms will also be brief. If sustained they will be prolonged.

The variations in gastroscopic findings are best integrated by the psychosomatic concept, which assumes both that the emotions affect the color and appearance of the stomach and that changing emotions are accompanied by prompt changes in the appearance of the stomach. Varying gastric juice and acid levels during the day and night are explained by the changing emotions experienced. Seasonal recurrence and frequency of recurrence are all related to the character structure of the patient.

The diagnosis of peptic ulcer is supported by finding a character structure which readily thrusts the patient into the peptic ulcer conflict situation.

The emotional reaction of the patient is held to be of greater significance than the particular diet or drugs utilized in the treatment. This does not preclude the possibility of developing measures to correct the anatomic imbalance in the stomach and duodenum associated with the ulcer type of conflict.

The concept according to this article that peptic ulcer is a psychosomatic disease, affords a better understanding of the many confusing manifestations of

cator is introduced into the wound to protect the skin edges. To avoid shock produced by frequent moving, a special trolley has been designed on which the patient can have both the operation and irradiation.

In summary of 33 patients, 15 were treated by direct irradiation. In 8 of these the disease appeared to be limited to an area that could be irradiated. Of this group one lived 24 months after treatment, 3, 15 months, one 7 months, one 4 months and one 3 months.

Although this series is small, the authors believe that direct irradiation at high intensity will prove to be a rational and important advance in the treatment of cancer of the stomach and other viscera. Although wider exposure is needed than for surgery alone, with adequate precautions the whole procedure should not be so shock-producing as wide surgical excision.

Since there was no precedent to indicate the probable effects of high tumor dosage given within a minimum of from 2 to 5 minutes, the earlier patients were treated with smaller doses than those that could be expected to be curative alone. Therefore these patients had supplementary external irradiation beginning within 10 days of the operation. Some had further external irradiation months later. The initial dose has been gradually increased, two tubes being used together to a maximum (to date) of 3,000 roentgens in 3 minutes over a field of 13 cm. minimum diameter. The authors hope eventually to be able to give an adequate initial dose so as to dispense with the later external irradiation. It is suggested that the hospital of the future will have a radiotherapy room adjoining the operating theater to facilitate direct irradiation in cases of inoperable carcinoma.

HAROLD LAUFMAN, M.D.

The Statistical Approach to Gastric Cancer. DIXON JENNINGS. *Brit J Radiol* 1947 20: 53.

Carcinoma of the stomach is the most important form of cancer in Western civilization. It probably accounts for about a fourth of all deaths due to cancer in individuals under the age of 70. The author attempts to bridge the gap which exists between the public health picture of the disease and the more personal picture which hospital records and individual experience present. An extensive statistical analysis is made which compares the incidence of gastric cancer in England and in the United States. It shows a remarkable parallel between the two countries. Diagrams are presented giving the age, sex, class and geographic distribution of gastric cancer, insofar as it can be depicted from available vital statistics. In some country districts it is difficult to persuade elderly patients to report to a hospital, and thus statistics are not always accurate. Of the patients referred to a hospital, more than half probably receive a surgical opinion, about a fifth have too advanced a condition or are suffering from some heart or chest condition which makes surgery impossible. Operability rates are inaccurate since many provincial surgeons prefer to confine their surgery to

types of disease with low operative mortality and a quick recovery. The surgeon in a big city has far greater freedom of action than his colleagues in a small one. Of from 3,000 to 5,000 patients referred to a hospital, from 1,000 to 3,000 will probably be laparotomized. From 300 to 1,000 will be subjected to some form of gastrectomy, and from 200 to 500 of these will survive the operation, but by the end of 10 years from 40 to 100 only are still surviving. If it is remembered that 100 per cent 10 year survival cannot be expected of patients subjected to gastrectomy as the average age is probably over 60, the long term survival rates after gastrectomy compare quite well with the results of radical operation in other forms of cancer.

The results in gastric cancer are bad at present, partly because of the age of the population affected and partly because of the long delay before operation. A study of cancer records in any big hospital shows that some of this delay could be avoided. More examinations, especially between the ages of 40 and 60, should be made and repeated. Furthermore, the radiologist and gastroscopist should work more closely together. There are no carefully planned statistical experiments to prove that one form of treatment is better than another.

HAROLD LAUFMAN, M.D.

The Péan Gastroduodenal Anastomosis after Gastrectomy; 100 Operations (Anastomose gastro-duodénale à la Péan après gastrectomie; a propos de 100 opérations). E. DELANNOY and G. LAGACHE. *Rev. chir.* Par. 1947 66: 93.

The indications and immediate results of the Péan gastroduodenal anastomosis following gastrectomy are discussed on the basis of 100 cases.

In order that this anastomosis may be done the duodenum must be intact. The mobility of the duodenum can be improved by detachment of the pancreas. Because of the better vascularization of the posterior surface, the authors prefer a right to-left gastrectomy with primary direct hemostasis to a left to-right procedure or gastric hemisection. An extremely thin, narrow falcid duodenum may constitute a contraindication to the Péan technique, but a thin duodenum frequently thickens on retraction following section, and its caliber may also be increased by a longitudinal incision of exactly 1 cm. in the middle of the anterior surface. The technique of the operation is described in detail with schematic drawings. Special precautions are urged to prevent injury to the wound margins and bloody effusions. For the gastrectomy the classic right to-left technique is used. The authors' technique for the gastroduodenal anastomosis closely resembles that of Allaines and is illustrated by schematic drawings. Special care is devoted to suture at the angles, a serosal "U" suture being employed at the inferior angle while at the superior angle a musculoserosal suture including successively the posterior and anterior gastric margins and anterior duodenal margin is used, and a second seroserosal suture is used to

From an etiological standpoint the stenosis may be caused by congenital anomalies as well as by acquired intraduodenal or extraduodenal diseases.

According to some writers the duodenum is normally slightly compressed and narrowed under the root of the mesentery and consequently a tendency to obstruction will result if the lumen is further diminished.

The author mentions the congenital causes of duodenal obstruction and refers to their types and mechanism.

Among the acquired causes of duodenal obstruction, apart from tumors mention should be made of gallstones which have perforated to the duodenum and subsequently impacted themselves either in the superior part of the duodenum or at the duodenojejunal flexure and produced a total or partial obstruction there. Apart from the choledochus the calculi most frequently leave the bile ducts through perforations of the duodenum next through the colon, and finally through other organs.

In other instances the calculi were not in themselves large enough to obstruct the lumen however they caused such an inflammatory hyperplasia of the pylorus as to obstruct the passage.

The author has had the opportunity to observe 3 cases of duodenal stenosis, 2 of which are reported.

Only a few cases of gallstones as the direct cause of obstruction of the duodenum are reported in the literature, and the author has therefore deemed it appropriate to recapitulate briefly the cases which he has succeeded in tracing in the literature.

It is seldom possible to map out the very cholecystoduodenal passage. When symptoms have been present they have taken the form of intensive stabbing pain thus resembling initially a perforation.

A brief account is given of the relation between megaduodenum and ulcer. HARRY W. FINE, M.D.

Study of the Vascularization of the Colon and the Anastomotic Arcades (Contributo allo studio della vascularizzazione del colon le arcate anastomotiche). ANDREA BERTOCCHI *Chirurgia* 1947 2 193.

The collateral vascularization of the mesenteric artery is of two types (1) dichotomic or consisting of two branches and (2) in arcade formation. The dichotomic divisions of the mesenteric artery together with the so-called primary arcades surround an area considered more or less avascular.

In certain sections of the colon the main or primary arcades form secondary arcades of the second, third and fourth order. They are found in the pelvic section of the colon regularly and with lesser frequency in the splenic and hepatic flexures they may also be found in the ascending transverse and descending colon. The terminal portions of the primary arcades together with the secondary arcades form so-called "Dwyer" parallel blood vessels, which have a course parallel to the intestinal axis. From them the long and short vasa recta originate.

The purpose of the arcades is to maintain the blood supply to all parts of the intestine in cases in which

there may be an interference with the blood supply to certain portions, as from impacted fecal matter paralytic ileus trauma torsion or mesenteric thrombosis.

Similar arcades can be found in only a few other places in the body such as the palm of the hand, junction of the nasal and facial arteries, intercostal regions, circle of Willis, and junction of the cerebrum with the spinal medulla.

The purpose of the arcades is twofold (1) maintenance of the blood supply and (2) maintenance of adequate blood pressure according to hemodynamic laws.

The presence of arcades counteracts the possible marked diminution of pressure at terminal ends of the blood vessels which might lead to nutritional and functional disturbances.

ARTHUR F. CIPOLLA, M.D.

One-Stage Resection and Anastomosis of the Colon
J. WILLIAM HINTON AND S. ARTHUR LOCALIO. *Ann. Surg.*, 1948, 127 12

One-stage resection of the colon without proximal colostomy is a safe procedure for nonobstructing lesions. The mortality morbidity and hospital stay are reduced. Careful preoperative preparation and attention to details of operative and postoperative treatment are essential for success. Aseptic anastomosis with the Furness clamp is a satisfactory and simple method.

The authors report a series of 26 consecutive colonic resections, covering all regions of the colon above the peritoneal reflection. They were done in one stage without a proximal colostomy or ileostomy and with septic anastomosis by means of the Furness clamp. The mortality was 3.8 per cent.

CHARLES BARON, M.D.

Rectosigmoid Cancer and Carcinoma of the Distal Sigmoid. Resection and Primary Anastomosis (Cáncer rectosigmoideo y de la porción distal del sigmoideo. Resección y enteranastomosis primaria). ARCEL N. CÁRMONICO. *Prensa méd. argent.* 1947 34 2319.

The operation of segmentary resection and primary enteranastomosis for treatment of cancer of the rectosigmoid and the distal portion of the ilio-pelvic colon gives satisfactory results.

This procedure justifies its election over abdominopelvic resection for the following reasons (1) there is only moderate mutilation of the normal anatomy, (2) the mortality is relatively lower (3) the anorectal sphincter is preserved (4) the normal intestinal pathway is re-established (5) complications involving the genital and urinary organs which occasionally are seen in abdominopelvic resections, are avoided (6) the period of hospitalization is shortened and (7) the patient is rehabilitated both physically and psychically.

The author presents 3 clinical cases of tumors of the sigmoid and rectosigmoid in which a primary enteranastomosis was done. In 2 of the 3 cases the

the aliment and makes available a more flexible and effective approach to them.

STEPHEN A. ZEEMAN, M.D.

Fifteen Years Experience with Free Feeding of Patients with Bleeding Peptic Ulcer; Fatal Cases. E. MEULENGRACHT *Arch. Int. M.* 1947 80: 697

Fifteen years ago Meulengracht introduced the 'free feeding' program in the treatment of bleeding peptic ulcer or gross hemorrhage with hematemesis and melena. This article deals with the results of 15 years of systematic use of free feeding.

The treatment consists of prompt and frequent feedings. From the first day after admission to the hospital the patients are given a full 'puree' diet. It was rather at random that the puree diet was chosen. Any other form of bland and nonirritating diet based on the culinary customs of the particular locality will do as well. Adherence to the principle of something to eat and drink from the first day and a varied and liberal diet given in frequent meals is the important factor.

A total of 1,031 patients with bleeding gastric ulcer were treated according to these principles. The material comprises only patients with gross hemorrhage i.e., distinct hematemesis or directly visible melena. Of the 1,031 cases, 26 terminated fatally during the patient's stay in the hospital. If all the fatal cases are included, the gross mortality was 2.5 per cent. If cases in which death was clearly or mainly due to causes other than bleeding are excluded, as well as those in which the patients died 24 hours after admission to the hospital and therefore before they had received the treatment, the net mortality was 1.5 per cent.

Relative to surgery the viewpoint given was that a patient with bleeding gastric ulcer should not be transferred for operation during or just after a hemorrhage, and a review of the fatal cases rather serves to strengthen this opinion even if there might be a few cases in which operation might be lifesaving. As shown by the fatal cases, operation may be considered when the patient is more than 40 years of age, and has persistent or repeated bleeding which manifests itself as hematemesis and threatens life in spite of repeated blood transfusions. There should be no serious contraindications to operation, the presence of an ulcer should have been proved by roentgenologic study and a good surgeon should be available.

STEPHEN A. ZEEMAN, M.D.

A Study of the Results, both Favorable and Unfavorable, of Section of the Vagus Nerves in the Treatment of Peptic Ulcer. WALTER WALTERS, HAROLD A. NEERLING, WILLIAM F. BRADLEY, JOHN T. SMALL, and JAMES W. WILSON. *Ann. Surg.* 1947 26: 679.

The authors' studies on section of the vagus nerves indicate that the results are inconsistent, variable, and in most cases, unpredictable. The pain relief obtained is probably brought about by the release

of gastrospasm and the reduction of gastric acidity as a result of the interruption of cephalic stimulation, and other factors not now understood. The expense of this is dilatation of the stomach with frequent troublesome retention of gastric secretion and, in some cases, food remnants. Moreover that relief of pain is not the result of healing of the ulcer must be considered, since in one of the cases observed an unsuspected acute perforation of duodenal ulcer developed.

Reduction in gastric acidity and disturbances of motility of the stomach and small intestine are of frequent occurrence after operation. In some cases such disturbances are temporary and in others they are prolonged, persistent, and troublesome. In such cases patients have complained of frequent belching of foul-smelling gas, a sensation of fullness and bloating after meals, and, in a few cases, nausea and diarrhea.

There have been 3 deaths in the hospital in the 83 cases observed; 2 of these could be attributed directly to cardiovascular accidents and one patient died of an unsuspected perforated duodenal ulcer with a subdiaphragmatic abscess. Gastroenterostomy had been done in association with gastric neurotomy.

In evaluating the results of the operation, it must be proved that an ulcer is present and that the vagus nerves have been completely sectioned. The authors' opinion is that the best approach is by means of a transabdominal incision for such an approach allows both examination of the ulcer and exploration of the gastrointestinal tract and performance of such procedures as might seem necessary to supplement gastric neurotomy. The greatest field of usefulness for gastric neurotomy seems to be in the treatment of ulcers after partial gastrectomy and in certain cases of nonobstructive duodenal ulcers in which the cephalic phase of gastric secretion is marked and pain is intractable. If the operation is used in the treatment of gastrojejunal ulceration after gastroenterostomy the possibility of obstruction at the stoma and at the site of the healed or reactivated duodenal ulcer must be considered.

In view of the inherent ability of the gastrointestinal tract to regain through anatomic and compensatory mechanisms its function after operative procedures which disturb neuromuscular continuity and since restoration of gastric acidity and gastric motility has occurred within a two year period in dogs in which gastric neurotomy has been performed, the possibility of such a return in human beings must be kept in mind constantly.

For the time being, the operation of gastric neurotomy must be considered to be in the investigative stage and the effects of the operation carefully studied.

Obstruction of the Duodenum with Special Reference to Gallstone Perforations. JOHN HARTZ. *Acta chir. scand.* 1947 96: 33.

Cases of duodenal obstruction although reported from time to time, are still of considerable interest.

From an etiological standpoint the stenosis may be caused by congenital anomalies as well as by acquired intraduodenal or extraduodenal diseases.

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Rectosigmoid Cancer and Carcinoma of the Distal Sigmoid. Resection and Primary Anastomosis (Cáncer rectosigmoideo y de la porción distal del sigmoideo. Resección y enteranastomosis primaria). ABEL N. CANÓDICO *Prensa med. argen.* 1947 34 2319.

The operation of segmentary resection and primary enteranastomosis for treatment of cancer of the rectosigmoid and the distal portion of the ilio-pelvic colon gives satisfactory results.

This procedure justifies its election over abdominoperineal resection for the following reasons (1) there is only moderate mutilation of the normal anatomy, (2) the mortality is relatively lower (3) the anorectal sphincter is preserved (4) the normal intestinal pathway is re-established (5) complications involving the genital and urinary organs, which occasionally are seen in abdominoperineal resections, are avoided (6) the period of hospitalization is shortened and (7) the patient is rehabilitated both physically and psychically.

The author presents 3 clinical cases of tumors of the sigmoid and rectosigmoid in which a primary enteranastomosis was done. In 2 of the 3 cases the

author practiced a transverse colostomy, and in the third case he made a cecostomy as an adjunct to the resection and enterostomosis.

Great importance must be placed on the following rules in preparing the patient for surgery (1) the bowel residue must be decreased (2) the serum protein should be at least 6.5 gm. per cent, (3) good intestinal drainage must be maintained, (4) the blood picture should be normal and (5) the intestinal bacteria must be combated with sulfasuxidine and sulfathalidine.

ARTHUR F. CROSSLAND, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Studies of Responses to Certain Hepatic Tests in Diseases of the Liver and Biliary Tract. Serum Cephalin Cholesterol Flocculation, Thymol Turbidity Thymol Flocculation and Colloidal Gold Responses. JOHN R. NEFF, P. REID BARRETT and JOHN G. REINHOLD. *Gastroenterology* 1947 9: 656.

Analysis of the responses of the cephalin cholesterol flocculation, thymol turbidity thymol flocculation, and colloidal gold tests in various diseases of the liver and biliary tract revealed that none offered a reliable means of differentiating between jaundice due primarily to extrahepatic bile duct obstruction and that due to intrahepatic causes unrelated to extrahepatic bile duct obstruction.

The diagnostic value of the individual flocculation test varies with the disease concerned and with the purpose for which it is used (in the detection of liver disturbance or in differential diagnosis). At least in the initial study of hepatic and biliary tract disease the use of all of these tests as a group offers more information than the use of any one or two of them. If only two tests are used the cephalin cholesterol flocculation and thymol reactions are preferred. No one test of this group is reliable for "screening" or for aid in differential diagnosis.

WALTER H. NADLER, M.D.

Clinical, Radiomanometric, and Therapeutic Study of Valvular Gall Bladders. A Purely Mechanical Form of Intersectocystic Dykinesia. (Étude clinique radiomanométrique et thérapeutique des vésicules à soupape. D'une variété mécanique pure de dykinesia intersectocystique.) J. CASOLI, J. HOFF and M. MICHAMON. *Rev. chir. Par.* 1947 66: 207.

Radiomanometric studies have revealed the valvular sphincter mechanism at the neck of the gall bladder to be just as important as that of the choledochoduodenal junction in the causation of biliary dyskinesia. The gall bladder in these cases is anatomically and histologically normal. Also cholecystography and the administration of fatty meals show normal conditions. Nevertheless, the symptoms may be of long duration. The condition is one of pure dyskinesia and dystonia. Stenotic cystitis can be excluded and there is no spasmodic occlusion of the vesical sphincter. Radiomanometry reveals a purely

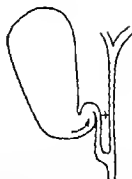


Fig. 2. Schmieden's schematic presentation of valvular obstruction of the neck of the gall bladder

mechanical disturbance of the valve mechanism caused by an apparently constitutional anomaly of the neck of the gall bladder. Schmieden was the first to draw attention to this anomaly (Fig. 2).

Biliary dyskinesia causes a very painful type of gall bladder hitherto not considered pathologic. Three cases are described in detail.

The paroxysms of pain are not as acute as in lithiasis but are definitely biliary in character with typical radiations and respiratory inhibition. There is no fever, but the pains recur incessantly at irregular intervals related or not, to the ingestion of food. This condition may persist for years, often beginning in adolescence. Associated reflex symptoms include vomiting, nausea, and gastric heaviness, and the general condition is always affected. There is a history of failure of medical treatment, and the patient finally presents a nervous state, frequently mistaken for a psychopathic affection.

X-ray examinations and intubations yield negative results. The motor function is preserved with an apparently paradoxical Graham-Boyd test. The only clinical sign is induced pain. Pressure in the region of the gall bladder causes a pain exactly like that experienced in the attacks. Cholecystostomy under radiomanometric control is indicated to disclose the source of the pain. Vesical decompression relieves the pain immediately. As the result of drainage, alimentation is facilitated and the general condition improves.

Radiomanometry during cholecystostomy shows a normal sensibility threshold but increased intravesical pressure causes pain exactly like that in the attacks. With decompression the pain disappears. These gall bladders usually fill at very low pressures (from 25 to 35 cm.). The valve effect is demonstrated by the contrast between the facility of exit of bile through the tube and the complete or incomplete obstruction of the contrast medium through the cystic valvular sphincter. A comparative analysis of radiomanometric studies of the valvular mechanism in the fasting state and following a fatty meal was made. To the astonishment of the authors, the fatty meal suppressed the obstruction in the neck of the gall bladder. The hormone cycle did not affect this condition. The cystic duct remained obstructed in

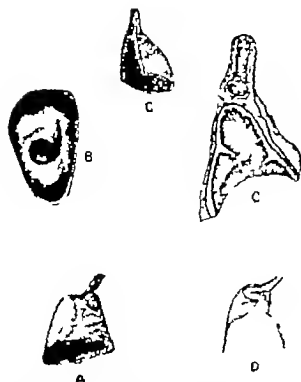


Fig. 2. (Caroli *et al*) Inclination of the cystic duct at its site of origin explaining obstruction due to kinking during distention of the neck of the gall bladder

the fasting state and permeable following a fatty meal. It was demonstrated that partial or complete obstruction in the fasting state was caused by distention of the neck of the gall bladder from below upward. Such distention takes place following even very moderate increase in intravesical pressure under radiomanometric control. The films show clearly that distention of the neck of the gall bladder leads to kinking by compression near the origin of the cystic duct. This obstacle makes the cystic duct and choledochus appear very small. The block is immediately released on the ingestion of fat. Ten minutes after such a meal, the gall bladder begins to diminish not only in width but in height. The vertical retraction of the major axis of the gall bladder forces downward the site of implantation of the cystic duct and straightens out the proximal kink when present and the lumen of the excretory canal is placed in alignment with the gall bladder cavity. The bile then escapes freely and the cystic duct appears to be normally filled.

The roentgenogram shows a pear-shaped gall bladder, because of incomplete differentiation of the neck and aplasia of its valves. This arrested development of the vesical neck is regarded as one of the causes of intracholecystic obstruction (Figs. 2 and 3).

Thus distention of the neck of the gall bladder may cause compression and occlusion of the cystic duct, whereas reduction of the major axis of the gall bladder by a fatty meal corrects the angulation and places the canal in a vertical position in prolongation of the vesical axis.

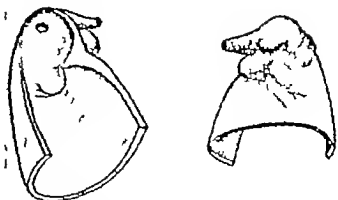


Fig. 3. (Caroli *et al*) Kinking of the cystic duct and valve at its site of origin

This condition is very different from that known as functional hypertrophy of the sphincter of Lutkens. Antispasmodics gave no relief. A differential diagnosis must be made from sclerosing cystitis. A type to be discussed in a future article is that in which kinking is due to atony of the gall bladder at the junction of the infundibulum and neck of the gall bladder. This might be designated as interfundibulocholecystic dyskinesia. The mechanism is similar to that described.

The good results obtained by administration of olive oil in some cases of biliary disturbance may be ascribed to the effect of fat in the conditions described. However in severe cases such treatment would be futile, for it would be too difficult to hinder painful refilling of the gall bladder day or night. In mild cases cholecystostomy may afford lasting relief. However in most cases cholecystostomy is only an initial stage permitting exploration of the bile tract. In two-stage operations there is always the risk of the development of adhesions. The diagnosis should be verified before cholecystectomy is done. The second stage consists of choleduodenostomy or cholecystectomy with a slight preference for the latter. Internal manipulations carry the added risk of biliary infection whereas cholecystectomy yields lasting benefit.

EDITH SCHAWCHKE MOORE.

Biliary Dystonias (Les dystonias biliaires) F. POUILLON and R. GUILLER *J. chir., Par.*, 1947 63 550.

In defining biliary dystonia, the authors emphasize the fact that this is a general and complex term including all changes of tonus in the bile tract. They wish to eliminate from their discussion in the present article all cases of secondary dystonia. In other words all cases associated with some macroscopic obstacle to evacuation. Only primary dystonias, of whatever etiology are included. Since the strictly vesicular dystonias have been well known since the work of Chiray and Pavel and because the new diagnostic procedure of radiomanometry permits a better understanding of the function of the biliary sphincters and of the excretory ducts, and may explain certain hitherto obscure clinical manifestations the present

article will be devoted to a pathologic study of the excretory channels and their sphincter apparatus.

Strictly speaking, the term *dyskinesia*, frequently used interchangeably with *dystonia*, pertains to conditions related to a disturbance in the motor function of the biliary passages without any change in the state of the muscles. In practice the two conditions are frequently associated or consecutive to one another.

Under the designation *biliary dystonia*, the authors will therefore discuss all functional conditions affecting the motor function of the excretory passages and the changes in function of their sphincter apparatus. In this study very special emphasis is placed on the value of radiomanometry as recommended by Caroli in 1941.

More recently Mallet Guy introduced the graphic registration of curves of biliary pressure which, besides affording purely numerical findings, shows the mode of reaction of the muscles of the gall bladder and choledochus to hyperpressure tests. Finally in 1942 he described a method of interoperative functional exploration yielding important information to guide the surgeon in his choice of treatment for a given functional disturbance. It is needless to state that to obtain valid results with these new methods, the exact technique described by their authors must be followed.

Emile SCHWARTZ MOORE.

Dystonias of the Gall Bladder (*Dystonies du systéme vésiculaire*). F. POILLIOT and GUY ALBOT. *J. chir. Par.* 947 63 558.

Radiomanometry of the biliary tract, pharmacodynamic tests and physiologic stimuli have demonstrated in man the existence of a sphincteric neuromuscular mechanism at the level of the neck of the gall bladder. This sphincter has greater contractile force than that of the sphincter of the choledochus. It varies individually and offers an explanation for certain constitutional morbid predispositions.

When the bile coming from the liver attains a certain pressure between the sphincter of Oddi and the vesicular sphincter the sphincter relaxes and the gall bladder fills. This filling can be hindered by morphine or the ingestion of fat. In evacuation of the gall bladder, this valve acts as a dam to keep pressure in the gall bladder from increasing the intracholedochus pressure. At the level of this sphincter there is a double, intrinsic and extrinsic innervation, the former playing a part similar to that of the Auerbach plexus in the intestine and the latter connecting this region with the general innervation. Any mechanical change, inflammatory lesion, or nervous disturbance in this neck of the gall bladder may give rise to serious functional disturbances of the gall bladder. The various vesicular dystonias of apparently primary type may be caused by (1) anatomic anomalies of the bile tract, (2) even slight local inflammatory changes, or (3) dysfunction of vesicular motility or of the cystic valvular sphincter apparatus.

Experimental and clinical findings point to the sympathetic system as an etiological factor in bill-

aryn dystonia, and therefore treatment should be directed toward its regulation.

Clinically hypotonia of the sphincter of Lutter resembles atony of the gall bladder but it causes less severe symptoms. Clinical examination yields negative results. Only the Murphy maneuver occasionally induces pain. Duodenal drainage yields an abundance of B bile, and is usually followed by improvement, especially of the migraine. Cholecystography confirms atony of the gall bladder. Radiomanometric findings are usually normal. The tonicity of the gall bladder is difficult to demonstrate by postoperative radiomanometry in a drained gall bladder. Occasionally the cystic pressure is low while the pressure at the sphincter of Oddi is normal. There are also formes frustes and atypical cases. Radiomanometry reveals only the low pressure required for filling the gall bladder and sphincter function, with functional integrity of the rest of the tract.

Cystic hypertension was first described by the author in 1944. In this condition there are acute attacks of pain in the subhepatic region, which may simulate hepatic colic, coming on after dietary indiscretions or emotional upsets. Or there may be only vague pain in the right subcostal region with heaviness in the epigastrium, or attacks of severe pain in the right iliac fossa with intestinal symptoms leading to futile appendectomy. Radiomanometric tests alone will reveal this condition.

Radiomanometric tests have shown that the gall bladder fills at a water pressure of from 15 to 30 cm., but the cystic canal yields only to higher pressures and may resist even 40 or 50 cm. of water pressure. Vasodilating drugs will overcome this resistance only temporarily. Cystic hypertension is occasionally accompanied by milder pain in the region of the sphincter of Oddi or may be associated with a mild cholecystitis or cholelithiasis. Here the purely functional disturbance may be the cause of the other two conditions.

Radiomanometric pressure tests have shown a pain threshold of induced pain which is constant in each individual and occurs normally between a water pressure of 30 and 40 cm., but never below 20 cm. The margin between the pressure required for transit of bile and the pain threshold is usually 10 cm. Some pain syndromes may be due to a drop in this threshold of sensibility which is caused by increased resistance of the sphincter of Oddi or by a lowering of the induced pain threshold, the pressures for transit through the sphincters remaining normal. This is the syndrome known as biliary hyperesthesia and occasionally associated with hyperesthesia of the urinary tract. It suggests a systemic dysesthesia. There are, of course, all degrees of hypotension or hypertension and frequently the milder forms are not strictly localized, or associated, as mentioned above, with other pathologic conditions of the biliary tract.

As regards the treatment of dystonias of the biliary tract, a proper evaluation of results is, of course, possible only in radiomanometrically controlled cases of recent observation. In older cases with uncertain

indicate the need for more extensive gastrectomy or vagotomy as part of the procedure.

The results observed in these animals, although disheartening, are yet promising enough to warrant further investigation. The most important factors in successful instances seem to have been careful surgical technique, adequate whole blood transfusion during operation, and careful postoperative care.

JOHN J. MALONEY, M.D.

Two Cases of Traumatic Rupture of the Normal Spleen (Su due casi di rottura traumatica di milza normale) MARIO BALLESTRERO. *Boll. Mem. Soc. piemontese chir.* 1947 7 439.

Traumatic lesions of the spleen may be divided into contusions, ruptures, wounds and hernias. Ruptures represent from 70 to 85 per cent of all the traumatic lesions of a normal spleen. They may be of two types: spontaneous, i.e. without evidence of external trauma, and traumatic in the strict sense of the word.

In descending order of frequency ruptures of the spleen are combined with rib fractures and injuries of the kidneys, lungs, stomach, liver, pancreas or colon.

A sharp distinction between a contusion and a rupture of the spleen cannot always be made. The following types of injuries may however be distinguished in the majority of cases: (1) subserous ecchymoses, (2) subcapsular or intraparenchymal hematomas, (3) simple rupture of the capsule, (4) multiple lacerations, and (5) cracks through the organ.

The author reports 2 cases of traumatic rupture of the spleen: one in a 16 year old boy, following a collision of a motorcycle which he was riding with an automobile, and the other in a 13 year old boy following a blow against the left hypogastrium.

The author draws the following conclusions from his observations: A traumatic rupture of a normal

spleen is rarely recognized, chiefly because of a lack of typical symptomatology. The latent period between the initial injury and the secondary hemorrhage which produces hemoperitoneum is the most important sign. In one of the author's cases the latent period lasted 30 hours.

A postoperative hyperthermia following the splenectomy is the most important complication. One of the author's patients developed a post-traumatic pleurisy but both of his patients recovered.

Due to the vicarious function of other organs, absence of the spleen is usually well tolerated by the patient, but he should be advised to limit his physical activities such as heavy sports.

JOSEPH K. NARAT, M.D.

The Value of Splenectomy in Certain Splenic Syndromes in Children (Considerazioni sulle splenectomie in alcune sindromi spleniche infantili). VITO TORIO FERRERO, PIERO FORMARA, CARLO ALDO SCHIAVINI. *Boll. Mem. Soc. piemontese chir.* 1947 17 451.

Splenectomy, which as a rule is better tolerated by children than by adults, was employed by the authors in 3 children suffering from Cooley's disease, or Mediterranean anemia. The effect on erythroblastosis was very pronounced in 2 cases as the number of nucleated red cells rose markedly. In the third case the curve was erratic. However the operation did not exert any permanent beneficial effect on the patients.

In 2 cases of the sclerocongestive syndrome, or Banti's disease, the results of splenectomy were not definite. In 1 instance an intensive gastrointestinal hemorrhage occurred 3 1/2 years after the operation.

On one patient with Werthof's disease splenectomy produced a beneficial effect. On the other hand in a patient with an atypical thrombopenic syndrome the results of the operation were dubious.

JOSEPH K. NARAT, M.D.

GYNECOLOGY

UTERUS

Endometritis Tuberculosa. RINGER ERIKSEN *Acta obst. gyn. scand.*, 1947 37: 249.

The author presents a superficial review of the literature concerning endometrial tuberculosis. The incidence pathogenesis diagnosis, and treatment are stressed.

He then presents 38 cases of tuberculous endometritis in patients treated in 40 Danish hospitals during the years from 1931 to 1940. The diagnosis in all of the cases was established by histological examination of the curettings. In no case was the condition suspected in advance. In 2 cases the diagnosis was corroborated bacteriologically once by culture and once by guinea pig inoculation of the uterine secretion or curettings. In all these cases the disease was apparently limited to the uterus and exploration revealed no signs of disorders of the adnexa. In 3 cases salpingography showed normal conditions.

This group of 38 patients constitutes 15 per cent of all cases of gynecological tuberculosis verified histologically which were reported from these same hospitals for the same period from 1931 to 1940. In the author's review of the literature one notes that tuberculosis localized exclusively to the endometrium represents about 10 per cent of the cases of genital tuberculosis found in postmortem examinations of adult women. However this reported incidence varies with the investigator from 1.77 to 28.6 per cent and as in the author's series exclusion of adnexal disease was not always absolutely certain.

The ages in this series ranged from 16 to 58 years with an almost equal distribution among the four decades from 20 to 60. In 36.8 per cent of the cases there was a history of tuberculosis elsewhere in the body. Among the married women there was an incidence of sterility of 53.3 per cent.

The predominant symptom which led patients to seek medical attention was metrorrhagia, which occurred in 44.7 per cent of the cases. Other complaints were vaginal discharge of an offensive odor in 23.7 per cent, sterility in 13.5 per cent, dysmenorrhea in 10.5 per cent, abdominal pain in 7.9 per cent, and postmenopausal bleeding in 7.9 per cent. Menorrhagia, amenorrhea, and lumbar pain also occurred.

The treatment of the 38 patients was varied. In addition to the curettage which was performed on all patients, 3 patients were subjected to hysterectomy, 3 were treated by roentgen irradiation, and 13 were treated with the carbon arc lamp. Only one of the hysterectomies was performed for the tuberculosis alone. One of the patients had, in addition, a prolapsing uterine polyp and another had a fibroid.

In 1935 all but 3 patients were followed up. More than half of them were examined. Twelve patients or 31.6 per cent complained or had complained of genital symptoms. Six or 15.8 per cent, developed

tuberculous salpingitis. In 2 of these the salpingitis occurred within a few weeks after the original diagnostic curettage. Two others of these 12 patients died, one of tuberculosis of the spleen and the other of tuberculosis of the adrenal glands. The tuberculous endometritis recurred with certainty in 5 cases or 13.2 per cent.

Of the 23 patients, or 60.5 per cent, who had no pelvic symptoms or signs following the original curettage, 4 developed tuberculosis in other organs which led to a fatal result in 3. A repeated curettage in 1 patient after 4 months, in 1 patient after 2 years, and in 1 patient after 5 years showed no tuberculosis. On the other hand, a repeated curettage in 8 other patients over varying periods of time showed the continued presence of the disease.

Two patients in this series gave birth to normal children and had a normal puerperium. The author discusses the relationship between pregnancy and endometrial tuberculosis in connection with these 2 cases and with 8 other similar cases from the literature.

L. JAMES TALBOT M.D.

Fibrosis Uteri. R. SOOMAKER AND J. E. KAMLER. *Arch. Path. Chic.* 1947 44: 633.

The criteria for the diagnosis of fibrosis uteri have never been clearly defined from either a clinical or a pathological standpoint. Many clinicians and pathologists deny the existence of the entity. The term was frequently used in reference to the asymmetrically and slightly enlarged uterus to which gross pathology could be noted and with a history of bleeding. The authors in this study made an attempt to determine whether the disease is a clinical entity or not, and to define the pathological criteria for making a diagnosis.

They identified four layers in the uterine wall: (1) the submucosa, (2) the vascular, (3) the supravascular, and (4) the subserosa. The dividing lines between them are indistinct. Among the 245 uteri studied, 27 cases of fibrosis uteri were diagnosed. All but 2 of the patients complained of profuse bleeding at the time of menstruation. None of the patients had prolonged bleeding. In more than half of the patients additional lesions were found. In all but one case the uterus was enlarged.

In fibrosis uteri one notes an abnormal amount of connective tissue occurring both between the muscle bundles and more characteristically around the individual muscle cells. This increase is due to an increase in the collagen fibers and not in elastic fibers or reticulum. It is significant that there is a greater percentage of fibrosis in the submucous layer than in the other layers.

Typically the patient gives a history of profuse menorrhagia without metrorrhagia and usually without dysmenorrhea. The uterus is typically symmetrically enlarged. The myometrium is pale

cent in group IV with 5 year cures. Groups I and II combined had a 5 year survival rate of 43.2 per cent and groups III and IV one of 13.9 per cent. It is thus evident that radiation therapy is approximately three times more effective in the earlier than in the later stages of the disease.

The author also analyzed the cases without 5 year survival after treatment. A total of 296 patients (54.7%) died in the first year after irradiation and 454 (83.9%) died within the first 2 years. Primary mortality from the therapy occurred in 39 patients (4.6%) classified from groups I to IV inclusive, 2, 10, 16 and 11 patients were in groups I, II, III and IV respectively. Death ensued from thrombophlebitis and embolism in 10 cases, hemorrhage in 1 case, cerebral hemorrhage in 1 case, cardiac paralysis in 2 cases, pneumonia in 2 cases, peritonitis in 18 cases, sepsis in 4 cases, uremia in 3 cases and unknown causes in 3 cases.

Although there were fewer cases of adenocarcinoma (55) than squamous cell carcinoma (731) the former seemed to respond better to irradiation since only 101 (27.5%) of those with squamous cell carcinoma lived more than 5 years while 22 (40%) of those with adenocarcinoma survived for the same period of time.

PATIENTS TREATED BY SURGERY

Within the 10 year period 110 patients with cervical malignancy received operative treatment.

About one-half (58) received preoperative radium (33 in group I, 24 in group II, 1 in group III). Thirty six (63.1%) survived 5 years. The average radium dose was 3,344 mgm. hr., but for group II the dose was less (2,770 mgm. hr.). The higher preoperative radium doses did not appear to increase the percentage of recovery. Operation is best performed about 6 weeks after the radium application.

Fifty-one of the 110 patients subjected to operation received no radium before surgery (40 in group I, 8 in group II, and 3 in group III). 31 (62.7%) lived 5 years. The following operations (with recovery rates) were performed: complete hysterectomy with bilateral salpingo-oophorectomy in 21 cases (47.8%), Wertheim operation in 63 cases (66.7%) and vaginal hysterectomy in 22 cases (72.7%). Four patients (3.6%) died primarily 2 after each of the abdominal procedures.

Although at present the trend is toward irradiation therapy the author believes that certain patients in group I should be treated surgically. Better results are attained in patients belonging to group II if radium is used preoperatively.

With postoperative recurrence prognosis is very poor.

ALL PATIENTS LIVING 5 YEARS

Of the 931 patients with cervical carcinoma, 263 (28.2%) lived longer than 5 years. Subdivided according to groups 61.8 per cent of those in group I, 42.3 per cent in group II, 19.9 per cent in group III and 3.6 per cent in group IV recovered.

The percentage of recovery rose perceptibly from 1937 on. This the author attributes to the greater

number of lesions seen earlier. It is highly desirable to treat as many patients as possible while they are in Group I, but results are so favorable in those of group II that if they belong to either group I or II 48.7 per cent or almost half can be cured.

WARREN R. LANG, M.D.

MISCELLANEOUS

Anticoagulation Therapy with Heparin/Pitkin Menstruum in Thromboembolic Disease Complicating the Puerperium and Gynecologic Surgery. HARRY J. GREENE and LEO LOEWY. *Am J Obst.*, 1947 54 958.

The clinical department of heparin/Pitkin menstruum has been observed in 53 patients representing all forms of venous thromboembolic disease encountered in obstetrical and gynecologic practice.

The authors present in detail their formulae, dosage plan, method of administration and the Lee-White modification of Howell's method for the determination of blood coagulation time used in following the patient's clinical course.

The disadvantages, complications and efficacy of other methods of treatment are compared to the use of heparin/Pitkin. These methods are the conservative medical treatment, surgical approach and anticoagulant therapy with dicumarol.

The span of treatment proposed for uncomplicated thrombophlebitis or phlebotrombosis (or both) was 10 days to 2 weeks. For patients with pulmonary embolization an additional week or two of therapy was required depending upon the extent of pulmonary infarction. In any event, the full effect of the heparin was present when the patient was first allowed out of bed.

The results in this series were satisfactory as judged by effective control of pulmonary embolization, marked amelioration of pain and discomfort, rapid recession of edema, reduction in morbidity, acceleration in convalescence, and virtual absence of residual edema, particularly when patients were treated without delay.

Most informative are the statistics with respect to the patients who had pulmonary embolization. There were 18 patients in this group with but one fatality representing 1.8 per cent of the entire series. The causative factors responsible for the one treatment failure have been analyzed.

As a result of observations of its clinical department, the subcutaneous administration of heparin in the Pitkin menstruum is recommended as a safe, simple, practical and effective method for anticoagulation therapy in thromboembolic disease complicating the puerperium and gynecologic surgery.

JOHN R. WOLFF, M.D.

Precursors of Corpus Carcinoma Estrogens and Adenomatous Hyperplasia. S. B. GUNBERG. *Am J Obst.* 1947 54 903.

A pattern of adenomatous hyperplasia of the endometrium is described which bears a constant rela-

tion to estrogen stimulation in both benign and malignant tissues. The author presents data concerning this endocrine tumor relationship in four related groups.

1 *Response of the human endometrium to granulosa cell tumor of the ovary.* The finding of hyperplasia of the endometrium in patients harboring such an ovarian tumor is well known. Increasing reports in the literature and the author's personal experience show that a significant percentage of those patients responded with endometrial malignancy. A striking degree of hyperplasia was noted in many of the author's cases of functioning ovarian tumors, and in one patient the condition was associated with endometrial carcinoma. These hyperplastic endometria may be placed in a graded progression of activity which moves quite readily toward the malignant one suggestive of an estrogen-cancer relationship.

2 *Hyperplasia of the human endometrium following prolonged estrogen administration.* Twenty human endometria with advanced degrees of hyperplasia produced by prolonged estrogen administration were studied. While none could be called malignant, several endometria showed characteristics similar to those produced by the stimulus of granulosa cell tumor.

3 *Adenocarcinoma of the human endometrium following prolonged estrogen administration.* The author presents abstracts of 5 cases which are extremely suggestive of an etiologic relationship and the histologic data supporting them are also of a pattern which makes the suggestion strong enough to be significant, and certainly to warrant further study. In some areas one gains the impression that this pro-

cess is but an intensification of an atypical adenomatous pattern of hyperplasia. One can see typical cystic glandular hyperplasia, atypical (metaplastic) hyperplasia, and adenocarcinoma side by side in some sections. The multifocal malignant processes, often separated by areas of typical hyperplasia, present the picture of a generally stimulated tissue which has responded more intensely in some areas. There is a characteristic pattern which constantly recurs through these tissues. It is almost papillary in form. It shares morphologic properties with other tissues known to have been stimulated by estrogens. Also presented are abstracts of three other corpus carcinomas and an ovarian adenocarcinoma whose histories indicate their development may have been accelerated by estrogen administration and their histologic pattern modified.

4 *Relation of hyperplasia of the endometrium to the development of corpus carcinoma.* In an effort to evaluate the endocrine background of patients with corpus carcinoma, their reproductive histories were studied and deviations were noted which suggest abnormality of internal secretions: an increased incidence of infertility, delayed menopause, and menopausal bleeding. Thus, these individuals who apparently have an increased susceptibility to corpus carcinoma demonstrate a significant frequency of endocrine stigmas of a type which has been associated with infrequent ovulation and probably noncyclic persistent unopposed estrogen stimulation.

The well defined histologic pattern recurring in these related groups of tissues suggests that endogenous or exogenous estrogens play a role in the development of corpus carcinoma.

JOHN R. WOLFE, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Face Presentation STEPHEN J. RUDOLPH, JR. *Am J Obst.*, 1947 54: 987

A series of 61 cases of face presentation occurring among 35 163 consecutive deliveries in the Philadelphia Lying In Hospital is analyzed in regard to etiology, management, and end results.

There was a high incidence of monstrosities: 5 of these were of the anencephalic type and 2 presented acraniorachischisis. In nearly 40 per cent of the cases the condition occurred in women with clinically normal pelvis who bore normal, average, or smaller than average infants and had no complications of etiological value. Of the 37 patients to whom etiologic factors were assigned 18 had abnormal pelvis and 12 had normal pelvis with large infants. There was one case of placenta previa, and one in which multiple turns of the cord occurred around the infant's neck.

There were no maternal deaths, but there were 12 fetal deaths, and only 4 of these occurred in babies who were normally formed and weighed more than 3 pounds. The death of 2 infants was due to poor obstetric judgment: one followed occult prolapse of the cord and one occurred antepartum; the cause unknown.

Delivery was spontaneous in 30 per cent of the cases; 25 per cent of the infants were delivered by forceps and by internal podalic version, and the remainder by cesarean section.

The author notes that the present trend is away from internal podalic version and breech extraction. With a decreasing maternal mortality and morbidity following cesarean section, the value of this procedure as a means of obtaining a living infant is increasing.

JOHN R. WOLFE, M.D.

LABOR AND ITS COMPLICATIONS

Local Anesthesia in Obstetrics ROBERT MACKAY *Med J Australia*, 1947 2: 595.

The author presents an excellent study on the use of local anesthesia in obstetrics. He introduces his subject with the comment that the technique described unlike other methods, has no effect on the unborn fetus. The time required for the introduction of the anesthetic is shortened by use of the Pitkin "Luer Lok" syringe connected to a small flask of 1.5 per cent solution of metycaine.

Two techniques are described: the first consisting of pudendal block, which is carried out in the following manner: a wheal is made on each side at the junction of the anterior two-thirds and the posterior one-third of each labium majus with a 22 gauge or 23 gauge needle; the labia are then infiltrated anteriorly up to the mons veneris and posteriorly and laterally down to the anus using the same wheals; a

long needle is then directed to the ischial spines, at which point 8 c.c. of the solution are injected. The levator ani are likewise injected, and a further injection is made slightly distal to the ischial tuberosity on each side.

The author describes three possible dangers—sepsis, intravenous injection, and the formation of hematomas—none of which he has as yet encountered. At the Women's Hospital Sydney Australia, local anesthesia is used routinely in patients with diabetes, cardiac disease, pulmonary disease, and severe pre-eclampsia. The fetal indications are prematurity and breech presentation. The clinical results have been remarkably good.

The technique of infiltrating the abdominal wall for cesarean section is carried out by making two skin wheals: one 2 cm. below the umbilicus and the other halfway to the symphysis. Subcutaneous injections are then made in a radial fashion from the two wheals. When the rectus sheath is exposed a needle is introduced beneath the anterior sheath and further injection is made. The fascia of the transversalis is likewise injected and at the same time, further injection in the retroperic area is carried out. After the peritoneum has been opened injections are made extraperitoneally. Frequently in the present series, sodium pentothal was used intravenously to supplement the local anesthesia. This was particularly necessary when the head was tightly wedged in the pelvic brim, and the clinical results were satisfactory. There was but one death that of a patient with mitral stenosis, due to cardiac failure 24 days after the operation.

Of 54 babies, 5 died. One of these was stillborn; one a premature infant who died of atelectasis; one died of erythroblastosis; and two died of anemia associated with placenta previa.

The author concludes that local anesthesia is safe for the mother and that it offers several advantages: namely, the reduction of postoperative complications (particularly a reduction in the occurrence of hemorrhage) and the excellent condition of the infants delivered.

JAMES F. DONNELLY, M.D.

Anesthesia in Labor and Cesarean Section CLIVE N. PATON *Med J Australia* 1947 2: 599

The author states that obstetric anesthesia is complicated by a number of basic factors: first that two individuals are subjected to the anesthetic agent and that the reaction of each may be different; second that regardless of the type of anesthetic, it is almost certain to interfere with the normal physiology of the labor; third that each of the three stages of labor call for a different type of anesthetic agent.

The discussion is divided into three main headings: namely, analgesia for the first stage of labor; anesthesia for the second stage; and anesthesia for operative obstetrics.

Nearly all of the known analgesic agents are discussed briefly their advantages and disadvantages being pointed out. In addition to his comments on the barbiturates, morphine, scopolamine, and demerol, the author mentions the use of trichlorethylene, which is self-administered by the patient from a specially designed semiautomatic inhaler. While not in common usage the technique of intravenous sodium pentothal drip analgesia is described. An interesting device was used to administer paraldehyde. This consisted of placing 17 minims of paraldehyde in capsules which were then frozen solid in a refrigerant and subsequently administered in this state to the patient. This eliminated the objection to the odor and taste of paraldehyde.

A wide variety of anesthetic agents for the second stage were described including chloroform, ether, nitrous oxide, low spinal, caudal and intravenous anesthesia. No clinical material was discussed.

In operative obstetrics particularly cesarean section, the anesthetist is faced with three major groups of patients. The first group consists of those patients who have obstructed labors but are otherwise in good health. The second group consists of patients who have medical complications such as cardiac disease, pulmonary disease, or toxemia, and the third group consists of those individuals who are either exhausted or who are in shock from blood loss or prolonged labor and infection.

Preoperative sedation was used in small amounts, the author's preference being morphine sulfate, gr. $\frac{1}{8}$ and atropine, gr. $\frac{1}{100}$. He expressed a preference for three types of anesthesia: cyclopropane, intravenous sodium pentothal with nitrous oxide and oxygen and spinal. All three have the advantage of minimal interference with the contraction of the uterus and very high concentrations of oxygen.

In conclusion, the author points out that no anesthetic has yet been found which is ideally suited for obstetric patients, and stresses the need of the psychological preparation of the pregnant woman for her labor and delivery. JAMES F. DOWDNEY, M.D.

Short Wave Therapy of the Pituitary Gland in Labor and in the Puerperium (La marconiterapia ipofisaria nel parto e nel puerperio). ENRIQUE GONZALEZ. *Ginec. obstet.* 1947 49: 1-3.

The author reports favorable results in 350 women in labor with either spontaneous or artificial rupture of the membranes following stimulation of the pituitary gland with short rays, and chemical and hormone therapy.

In simple uterine inertia, short wave therapy of the pituitary gland in conjunction with hormonal chemotherapy hastened the dilatation of the cervix and shortened the period of labor.

With this therapy in patients with placenta previa marginalis, following expulsion of the placenta, there was a physiological contraction and retraction of the uterus with less blood loss than was considered physiological and in all cases the third stage of labor occurred within 10 minutes.

In subinvolution of the uterus, stimulation of the pituitary gland favored contraction of the uterus and increased its tone.

The following technique was used: short waves having a length of 6 meters were applied through two electrodes in the temporal region. The first application was for 10 minutes but could be repeated in 4 hours.

Contraindications to this form of therapy are arterial hypertension, cardiac involvement, kidney pathology, retention edema, arteriosclerosis, syphilis, tuberculosis, localized and generalized infections, and disproportion between the fetus and the pelvis.

ARTHUR F. CIPOLLA, M.D.

Shock in Obstetrics. H. L. SHERRAN. *Lancet* Lond. 1948, 1.

Shock in obstetrics seems to be clinically and pathologically the same as shock in other types of cases except for the etiology.

This article is based on a clinical study and post mortem examination of 147 fatal cases of shock in relation to labor at the Glasgow Royal Maternity Hospital and on the clinical study of many other shocked women who recovered. The deaths occurred within 2 to 18 hours of the onset of shock. Many patients who died of shock also had hemorrhage, sometimes serious, but patients who died essentially as a result of hemorrhage are not included. The 147 cases were about one-third of those autopsied over a 10 year period.

The author believes that work done on shock in anesthetized animals is not comparable to their series of cases. The great majority of antepartals here reported were done within one hour of death and many within 15 to 30 minutes after death.

Clinical evidence suggests a very great reduction in blood flow through the skin muscles, and abdominal viscera. A pale, cold skin, the capillaries of which filled very slowly after pressure was applied furnishes evidence of this. Small contracted deep veins difficult to enter through which fluids had to be forced under pressure, furnished evidence of the slowness of the deep circulation. Even the deeper visceral organs showed evidence of this slowed circulation such as anuria of the kidney in shock. The author believes the brain is the last to show evidence of shock because patients frequently remained conscious until just before death.

He suggested that most of the manifestations of shock are due to a vasoconstrictor mechanism which reduces blood flow to the skin muscles, and abdominal viscera, although it does not interfere with the blood flow through the brain. This slowing of the blood flow through most of the body leads to reduction of the blood returning to the right heart which interferes seriously with heart function and leads to low pulse pressure and low arterial pressure.

In hemorrhage the vasoconstriction is temporary until the blood volume is restored. In pure shock the author states the body appears to bring the defense mechanism in to very powerful and protracted action.

to deal with a hemorrhage which has not occurred. This leads to poor venous return and a particular type of cardiac failure. He questions the use of adrenalin or pituitary extract in these cases. He says the production of this shock is by some unascertained stimulus, possibly nervous or biochemical. He believes transfusions are of little or no help.

The author gives the causes of shock in obstetrics as prolonged labor, ruptured uterus, retained placenta, and accidental hemorrhage, with particular emphasis on labors prolonged beyond 3 days and the third stage which has lasted over 2 hours.

BYRON F. HASKETT, M.D.

PUERPERIUM AND ITS COMPLICATIONS

The Venous System in the Puerperium (Sistema venosa e stato puerperale) ANTONIALE ZAMBONDI
Riv Ital gine 1947 30 135

Varicosities and phlebitis are the most important pathological conditions of the venous system in the puerperium.

There are two hypotheses for the origin of such varicosities during pregnancy: (1) compression of the blood vessels in the pelvis and (2) vasoconstriction produced by the pregnant uterus through other than mechanical factors. The first theory invites criticism because no varicosities are produced by tumors larger than the pregnant uterus at term, also twin pregnancy, hydramnios and genital tumors combined with pregnancy are observed without the presence of pronounced varicosities.

New biologic factors point to the importance of toxic and endocrine factors in the genesis of varicosities. Varicosities may develop simultaneously with the appearance of the first menstruation and show a certain periodicity.

Secretions of the pituitary gland seem to play an important role in the etiology of varicosities during pregnancy. The hormone regulates the tone of the smooth muscle. During pregnancy the muscles are relaxed and this may contribute to the development of varicosities.

Another theory states that some ovarian substance enters the circulation and directly influences the vasomotor apparatus.

Some authors call attention to the fact that chromaffin tissues of the suprarenal gland are depressed during pregnancy.

Three types of phlebitis may be distinguished—periphlebitis, mesophlebitis and endophlebitis—according to the location of the inflammatory process. From the bacteriological point of view two types may be distinguished—septic and aseptic.

The type that occurs during the puerperium is attributed to atony of the uterine wall with slowing up of the circulation and qualitative modification of the blood, such as an increase in fibrin content and an increase in the number of leucocytes. Septic phlebitis may be of embolic origin, the most frequent micro-organism found being the streptococcus.

ARTHUR F. CIPOLLA, M.D.

NEWBORN

A Creeping Infection of the Umbilicus (Die schleichende Nabelinfektion) B. DE RUDDER. *Dent med Wschr.*, 1947 73 497

The author reports 122 cases of umbilical infection in both bottle and breast fed newborn infants. Although this type of infection has been known for a long time it has occurred with increasing frequency since the war years. Of the total 122 cases 115 occurred since 1940 and 75 since 1945.

The infection is most often discovered in the period from the second to the sixth week of life. Externally there may be no sign of inflammation or granulation. Diagnosis is made by careful probing of the umbilicus which causes a discharge of pus, usually very minute in quantity. Pyogenic cocci are found on smear and culture.

In addition to fatal termination due to peritonitis (6 cases) and to umbilical sepsis (15 cases) a picture of severe nutritional disturbance, either acute or subacute, is seen. The majority of cases observed presented this disturbance.

Treatment consists of the administration of sulfonamides (or penicillin, the latter only recently) short wave diathermy and blood transfusion.

Of the 122 cases reported, 81 (66%) ended fatally in spite of intensive therapy.

WARREN R. LANG, M.D.

MISCELLANEOUS

The Principal Factors of Blood Sedimentation in the Course of Pregnancy and in the Sequel of Normal and Pathologic Labor (Les principaux facteurs de la sédimentation sanguine au cours de la grossesse et dans les suites de couches normales et pathologiques) J. BABIN and G. COMAS. *Rev Méd.*, 1947 2 396.

The authors have used the technique of Jayle and Badin in the study of pregnancy and the puerperium to establish the part played by the principal factors in the acceleration of the sedimentation speed which is always marked in these conditions. To avoid partial coagulation of the blood they have utilized a 20 per cent solution of sodium citrate at the rate of 1 c.c. in 10 c.c. of blood and have compensated for it by increasing the calcium concentration of the coagulating fluid (1.25 gm. of fused calcium chloride in 100 c.c. of physiologic saline solution).

In the course of pregnancy the sedimentation speed is accelerated from the second to third months on and increases up to term when it reaches its maximum. In order of importance the factors responsible for this acceleration are a considerable increase of the plasma factor in relation to elevation of the rate of fibrinolysis and a qualitative modification of this fibrillar substance, a progressive and very moderate increase of the serum factor and a decrease in the number of the red cells.

Normally, 10 days after delivery the sedimentation speed is close to that of the fourth to sixth

months of pregnancy but is nearly exclusively determined by the increase of the plasma and serum factors

In case of phlebitis or endometritis the sedimentation speed is very rapid and the factors responsible for the acceleration are, in the order of their importance, a strong increase of the serum factor, an increase of the plasma factor and a decrease in the number of the red cells. It is possible to use the finding of such a humoral syndrome in practice as it denotes in all probability a complication of the puerperal state even if the complication is not clinically apparent. Thus if the serum factor and the haptoglobin show values of less than 35 and less than 2 respectively the immediate danger of phlebitis may be rejected. If the serum factor is over 50 and the haptoglobin over 3 there is certainly an infectious condition present and the probability of phlebitis if the clinical signs are suggestive without yet being certain. In addition the measurement of the serum factor and of the haptoglobin seems to be an excellent means of verifying the evolution of phlebitis toward cure and of foreseeing possible recurrences. If the phlebitis heals without complications, the serum factor and the haptoglobin decrease but do not necessarily remain parallel: often one decreases before the other which suggests orientation toward cure. In any case, cure of the phlebitic process is certain only when the serum factor has become lower than 30 and the haptoglobin has become lower than 1.7

A syndrome similar to the former but less accentuated, is observed in the normal cesarean section.

In the sequel of normal pregnancy after a serious hemorrhage of labor the sedimentation speed is very rapid but the responsible factors are different, the most important being the decrease of the number of red cells: the other factors are in the order of their importance the increase of the plasma factor and the increase of the serum factor

RICHARD KROEL, M.D.

The Evolution of Pulmonary Tuberculosis after Delivery (*Evolucion de la tuberculosis pulmonar despues del parto*) VICTOR MANUEL AVILA B. FERNANDO RODRIGUEZ, and JOSE ORTIZ. *Obst. ginec. Bol. Mex.* 1947 5: 273.

In a study of 32,053 childbirths the authors found 658 women afflicted with pulmonary tuberculosis between the third month and second year following delivery.

In this 10 year period, the condition became worse in 28 per cent, remained stationary in 30 per cent, and showed improvement in 42 per cent. The disease grew worse in women of the ages between 25 and 35 years which was associated with an appreciable multiparity.

The mortality rate in this group was only 2.7 per cent.

Special importance is placed on the rest cure, but in some cases surgical treatment is necessary.

ANTHONY F. CIPOLLA, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY AND URETER

Hypertension in Unilateral Renal Disease. HILBERT S. SABIN. *J. Urol.*, Balt. 1948 59 8.

The author reviewed the clinical observations and experimental work associating the various lesions of the urinary tract with elevated blood pressure. He states that from the evidence now available we can only conclude that in experimental renal hypertension interference with the renal circulation results in the release of a pressor substance, but we do not know how this is brought about. That certain hypertension with unilateral renal disease have been improved, and in some cases cured, by nephrectomy has been definitely shown. The author reports a case which seems to fall in the category in which nephrectomy is indicated.

The patient, an 8 year old white girl was in normal health until 3 years prior to hospital admission. At that time she first complained of severe headache accompanied by nausea and vomiting which persisted for about 8 hours and then disappeared. Similar attacks occurred at increasingly frequent intervals during the ensuing 3 years until June 1946 when she was experiencing them as often as 4 times weekly. On June 12 1946 she was hospitalized and an appendectomy was done. Twenty four hours following the operation convulsions developed and persisted intermittently for 23 hours. Between seizures, she complained of violent headache and vomited frequently. Following the second convulsion there was complete loss of vision.

The past history revealed no symptoms referable to the urinary tract.

Physical examination revealed a girl of 8 years who was complaining bitterly of headaches and was completely blind. Examination of the fundi showed two dipters of papilledema bilaterally. There were flame shaped hemorrhages in the macular regions. The retinal veins were distended and there was tortuosity of the arteries with some fragmentation. There was a soft blowing apical systolic murmur and accentuation of the second aortic sound. The blood pressure readings were as follows: right arm, 190/165 left arm, 185/160 right leg 220/170 and left leg 215/170.

The red blood count was 5,040,000 with 13.5 gm. of hemoglobin and the leucocyte count 7,700 with a normal differential. The urinalysis was normal except for the finding of 200 mgm. per cent of albumin and a few white blood cells in the urinary sediment. Urine culture was positive for the *Pseudomonas aeruginosa*. The Fishberg concentration test revealed specimens of 1:017 1:018 and 1:020 specific gravity. The blood nonprotein nitrogen was 24 mgm. per cent and 90 per cent of phenolsulfonphthalein was excreted in 3 hours. An intravenous pyelogram revealed prompt concentration of the dye by the left

kidney, which appeared to be considerably enlarged but otherwise normal. There was poor concentration of the dye by the right kidney which seemed to be markedly atrophic. Cystoscopic examination revealed a normal bladder. It was impossible to obtain a specimen from the right kidney. Indigo carmine was excreted in good concentration by the left kidney in 4 minutes. Retrograde pyelograms confirmed the previous finding of a large but otherwise essentially normal left kidney and an atrophic right kidney.

The patient was maintained on bed rest for a period of 6 weeks during which time her blood pressure fluctuated between 230/170 and 150/120 the average being 170/130. There was partial recovery of vision during this time but she continued to complain of almost constant severe headaches and the child suffered occasional bouts of nausea and vomiting.

On July 26 1946 the small atrophic right kidney was removed under ether anesthesia.

The specimen consisted of a right kidney and pelvis which weighed 16.5 gm. and measured 5 by 2.5 cm. The capsule was slightly thickened but stripped readily. The entire surface was markedly congested and there were a few small subcapsular hemorrhages. The pelvis seemed dilated and its walls were very thick and fibrous. On section there was a definite diminution of the amount of cortex and the division between the cortex and medulla was poorly defined. The blood supply was apparently normal. The majority of the renal parenchyma was replaced by fibrous tissue.

Microscopic examination showed remarkable fibrosis with sclerosis of the blood vessels and glomeruli many being completely obliterated and the walls of others greatly thickened. There was great distortion of the tubular structure and many tubules contained hyaline casts. There was diffuse leucocytic infiltration in some areas plasma cells predominating. The picture was that of chronic arteriosclerosis.

The diagnosis was chronic arteriosclerosis and chronic pyelonephritis.

Postoperatively the blood pressure fell to an average level of 130/90 with a range of from 118/80 to 136/94. There was prompt disappearance of the headaches nausea and vomiting. Following a course of sulfonamide therapy repeated urinalyses were normal except for a faint trace of albumin. Examination of the fundi revealed disappearance of the papilledema and retinal hemorrhages although blurring of the disc margins persisted. Vision was 20/30 in each eye. This improvement has now persisted for a period of 6 months, and while the blood pressure is somewhat higher than normal for a child of this age, still she has resumed ordinary activity and is clinically well.

results but small cysts in the remaining kidney may enlarge and the prognosis then becomes uncertain.

The disease in adults occurs with impairment of the general health between the ages of 40 and 60 years. In the final deterioration the fatal issue comes rather unexpectedly.

Only a small proportion of patients have hypertension. An advanced hypochromic anemia can exist as in any patient with marked renal impairment. The anemia is proportional to the increase in the non protein nitrogen and is held to be the result of toxic damage to the bone marrow caused by the uremia.

Acute symptoms arise in polycystic kidney disease in the form of fever and severe pain. It is only when the fever becomes prolonged lasting leucocytosis appears and massive hemorrhage or abscess formation takes place that surgical intervention becomes necessary.

Palpation of the kidney is considered to be the decisive factor in establishing the diagnosis. In early cases the diagnosis can be established only after x-ray examination.

The exposure of the kidney with puncture of as many cysts as possible the Rovsing operation was first regarded as an emergency operation a purely palliative intervention. The operation of puncturing cysts now has become more common in cases in which there is rapid destruction of kidney tissue.

Attacks of pain and fever may regress under treatment with analgesics and antispasmodics. Rovsing's operation should be performed for

1. Perinephritis and infected cysts.
2. Large hemorrhages.
3. Threatened uremia.
4. Rapid deterioration of kidney function.
5. Rapidly increasing hypertension.

In the first case the author reported the patient had an enlarged left polycystic kidney. Many of the cysts were punctured some of them were opened and the outer walls were excised and painted with a proprietary sclerosing solution. The right kidney was apparently normal. The patient had a favorable result. The second and third cases were only temporarily improved by this type of operation.

The author concluded that the results of the Rovsing type of operation must be judged on the basis of urological examination renal function tests urinalysis intravenous urography and determination of the blood pressure. The patient's subjective symptoms are of only secondary importance in evaluation of the results of operative removal of the renal cysts.

CORRAD A. KUTERN, M.D.

Ureterointestinal Anastomosis. R. H. FLOCKE, J. Urol. Balt., 1948, 59, 21.

A review of the literature in regard to uretero-intestinal anastomosis reveals that all of the many different types of operations may be divided into the two following classes:

1. Modification of Coffey's technique in which the ureter is divided and imbedded submucosally in its intestinal bed.

2. The method using the intact ureter in which the ureter is not first divided but is implanted submucosally in its intestinal bed and later communication with the bowel and division of the distal ureter is carried out.

Difficulty in connection with the first type of operations have been early obstruction and infection of the urinary tract, leakage with peritonitis or extraperitoneal leakage if an extraperitoneal modification of this technique was used and later obstruction and urinary tract infection. It has been shown that inflammation in the periureteral bed is the cause of these difficulties and that the breakdown is due essentially to a spread of infection from the lumen of the bowel upward to the periureteral bed. There has been a lesser incidence of these complications in young patients in good general health and in more recent cases in which newer chemotherapeutic agents were available. However the uncertainty of the occurrence of these complications in all groups is outstanding.

The difficulties which arise in connection with the second type of operations are of a different sort. Inasmuch as the ureters were implanted intact, early breakdown of the anastomosis with leakage and peritonitis did not occur. However, urinary tract obstruction and infection occurred as did anuria or marked oliguria when bilateral anastomosis was performed. If these were overcome or did not occur then difficulties arose with regard to making the intestinal communication. This was accomplished by various methods the results of which were sometimes uncertain or required a rather extensive secondary procedure. Good results have been reported in both groups however the results are uncertain. This uncertainty is apparently related to local breakdown in the anastomosis in operations of the first type, and to surgical edema kinking or technical difficulty in making the communication in operations of the second type.

The author's experience coincided with the reports in the literature and the review of that material showed that in the cases in which the intact ureter was used early breakdown never occurred, while in the cases in which the intact ureter was not used there was a definite incidence of local infection and breakdown which occurred even with careful bowel asepsis careful placing of sutures, and avoidance of contamination. This occurrence was uncertain, but more frequent in older individuals than in children. It occurred even with the use of very intensive chemotherapy. Injection studies revealed that the ureter has an excellent arterial supply which is distributed from both the proximal and distal ends and along its course. The arterial supply within the ureteral wall could be outlined by injection from either end. However it was found that if one injects the arteries of the human cadaver having first divided one ureter as in operations of the first type, the density of the arterial supply in the divided ureter seemed definitely less than in the undivided one. This would seem to indicate that its nutrition

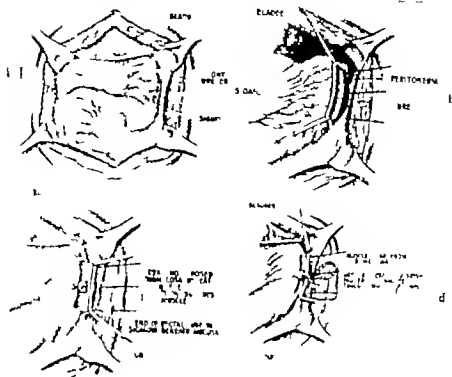


Fig. (R. H. Flocks). A method of ureterointestinal anastomosis. a, Exposure. b, Incision is made in parietal peritoneum, and the ureter is exposed and brought up into the abdominal cavity. c, Incision is made along the surface of the sigmoid for about $\frac{1}{2}$ inch, down to the mucosa. The rectal tube, which has been pushed up into the lumen of the sigmoid, can be seen underneath the mucosa. The incision is in the wall of the bowel and the exposed portion of the ureter are fitted together so that they will fit nicely. d, A small incision has been made into the ureter and No. 7 or

No. 8 ureteral catheter is passed up into kidney pelvis. A tiny incision is then made in the mucosa of the bowel right over the rectal tube. I to this the other end of the ureteral catheter has been placed. It is pushed down into the lumen of the rectal tube so that it comes out of the anus underneath the drape. An assistant then pulls out the catheter so that the sides of the opening of the ureter and the opening of the bowel can be approximated with interrupted black silk sutures about the ureteral catheter in exactly the correct position.

had been definitely disturbed and thus its viability and ability to resist infection had been impaired. Certain clinical observations seem to confirm this concept. It has been observed that the end result of cutaneous ureterostomy varies in an uncertain manner. In some cases the operation left a good, healthy stump and in others the stump sloughed down below the skin. Similar uncertainties have been observed in tube grafts, since they depend on the arterial supply from both ends of the tube for nourishment. These observations would seem to indicate that the principal advantage to be derived by the use of the intact ureter is the improved blood supply and consequently improved tissue viability, which in turn aids in overcoming any infection which might occur in connection with the anastomosis.

above and below. In the severed ureter blood may enter only from the proximal portion. Slight edema causing pressure may so deplete the blood supply that even though slough due to this alone does not occur resistance to infecting organisms is greatly reduced. Therefore the author believes that the importance of the principle of the intact ureter is not invariably a question of contamination of the ureteral bed with organisms, but rather the maintenance of adequate ureteral blood supply.

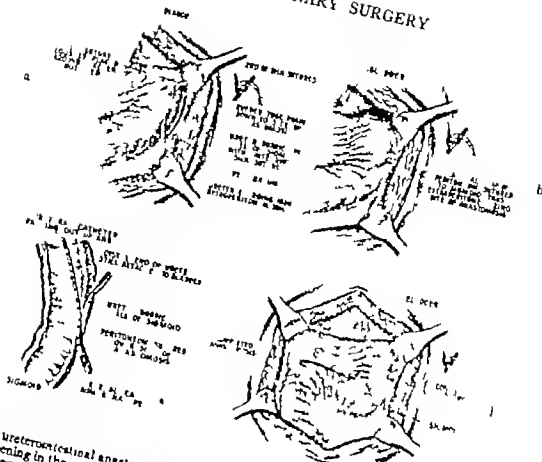


Fig. 3. A method of ureteroenteric anastomosis (continued). *a*, After the opening in the ureter and the opening in the bowel have been approximated snugly about the ureteral catheter the whole region is buried with interrupted black silk sutures by suture of the edges of the incision in the bowel over the ureter it being buried for a distance of about $\frac{1}{4}$ inches. *b*, The whole region of anastomosis is then buried with interrupted black silk sutures, with suture of the parietal peritoneum to the wall of the bowel over the region of the anastomosis and complete suture about the region of the anastomosis. The silk suture which has been placed about the distal portion of the ureter is brought out through a stab wound just in front of the anterosuperior iliac spine and the region of the anastomosis is

also drained with a rubber tube drain and sometimes a pack. This silk suture is tied two weeks later. (The second stage consists of tying off the ureters a weeks later after this procedure. They are tied off by simply tying silk sutures extraperitoneally through stab wounds on each side. This is surprisingly easy to do and takes only about 10 minutes. Thus the operation has been performed relatively easily.) *c*, Diagram showing cross section of the region of anastomosis. It illustrates the ureteral catheter as it goes from the ureter through the incision in the ureter and bowel out through the lumen of the bowel and out through the anus. *d*, Completed operation on both sides.

edema or kinking is obviated and (3) because the anastomosis is completed in the first stage, no second operation of great magnitude is necessary inasmuch as the second procedure is done extraperitoneally away from the region of the anastomosis and is a minor one.

The patient is prepared by the use of the Levine tube, parenteral feedings, and sulfasuxidine given by mouth for several days prior to operation. Enemas (until clear) are given the night before the operation and the rectosigmoid is irrigated thoroughly again after the patient is on the table. A silk and wax rectal tube is then inserted and left in place. A suprapubic incision is made and the abdominal cavity entered. The region of the sigmoid and the lower portion of the ureters are exposed. The peritoneum is incised, and the intact ureters are freed by blunt dissection. A closely adjacent portion of the

sigmoid is selected and a bed for the ureter prepared by splitting the serosa of the sigmoid. Three traction sutures of fine black silk are then placed in the lateral free flap of the bed and passed under the ureter to facilitate its approximation to the open bed. The rectal tube is now manipulated so that its open end is presented to the previously prepared bed of the sigmoid beneath the mucosa, and a single black silk suture is passed through the serosa of the ureter and the muscularis of the sigmoid on either side of the open end of the rectal tube. The ends of the suture are held in position but not tied. A small stab wound is now made in the sigmoid mucosa penetrating into the open end of the rectal tube. An opening of adequate size is made in the rectal tube. An opening corresponding level between the ureter at the corner. A ureteral catheter is then inserted in the ureteral opening up to the kidney pelvis and the

opposite free end inserted through the opening in the sigmoid into the rectal tube. The rectal tube is now withdrawn gradually until the ureteral catheter can be grasped and straightened out by the assistant. The previously fixed silk sutures about the region of the anastomosis are now tied and the bed in the sigmoid is closed over the ureter by means of later ruptured black silk sutures. The region of the anastomosis is extraperitonealized by suturing the lateral leaf of the parietal peritoneum to the sigmoid. A heavy steel or silk suture is placed untied around the distal portion of the ureter emerging from the anastomosis and is brought out through a stab wound near the anterior superior iliac spine, extra-peritoneally and adjacent to a pack or rubber tube which maintains an open anus to the site of the ligature. After a similar procedure is carried out on the opposite side, the midline incision is closed in the usual manner without drainage. The ureteral catheters are now secured to the skin adjacent to the anus by steel sutures. It is usually not difficult to keep the catheters draining freely but if they clog the urine appears promptly in the rectal tube which is left in place after the operation. A Wangenstein suction apparatus is used for 3 days, following which the diet is gradually increased. Two weeks later under pentothal anesthesia the sutures in the distal ureters are tied under vision by enlarging each lateral incision slightly and the drains in the small lateral incisions are removed. By this time the patient is operating a normal diet, and is beginning to establish his new bowel habits.

Thus a new method of ureterointestinal anastomosis prior to total cystectomy is presented which is simple and has the following advantages: (1) by the use of the intact ureter the blood supply to the region of the anastomosis is maintained; (2) by the immediate creation of an anastomosis under vision around the ureteral catheter the danger of ureteral obstruction due to surgical edema or kinking is avoided; (3) since the anastomosis is completed in the first stage no second operation of great magnitude is necessary; and (4) ureterointestinal communication can be accomplished under direct vision.

In 12 patients a total of 23 ureters were transplanted into the colon by the method described. All of the patients but 2 were between 54 and 74 years of age. These 2 were 37 and 45 years of age respectively. In no case has there been local breakdown or death due to the operative procedure. In 1 case death occurred while the patient was still in the hospital, 4 weeks after operation. The cause was cardiac failure. The transplantation had been working nicely but postmortem examination showed a large inoperable carcinoma of the bladder. The left kidney was destroyed and the ureter therefrom had therefore not been transplanted. The ureterointestinal anastomosis had healed perfectly 4 weeks after operation.

The postoperative course of the 11 other patients was not remarkable. Studies of the renal function were normal and the postoperative intravenous

pyelograms were either normal or showed moderate hydronephrosis. The oldest patient was examined 9 months following the transplantation and showed a normal pair of kidneys.

ROBERT O. BEADLER, M.D.

BLADDER, URETHRA AND PENIS

Multiple Calculi of the Urinary Bladder (Litiasis vesical multiple) P. GAURA RASPALE. *Arch. ital. med.* 1947 4 35.

Twenty five per cent of the author's 40 patients had more than one stone in the urinary bladder the number ranging from 1 to 44. Although urinary stones are usually observed in elderly persons, one patient was 6 and another 16 years of age. With the exception of one patient, all of them belonged to the male sex.

In 8 of 10 patients lithiasis was associated with a fibroadenoma of the prostatic gland in one with cervical scleroses and in the last with stenosis of the urethra and diverticulum of the bladder.

Primary stones or those originating in the bladder consist of urates and oxalates, while secondary stones or those descending from the kidneys are formed by phosphates.

JOSEPH E. NARAY, M.D.

GENITAL ORGANS

Contribution to the Study of Free Bodies in the Vaginal Sac of the Testicle (Contributo allo studio del corp liber della vaginale del testicolo) GIOVANNI D'ERICO. *Gior. ital. chir.* 1947 2 435.

At operation for right hydrocele of 2 years' duration in a man of 53 the author found a white hard fibrous spherical body, the size of a small grape, floating in the fluid the testicle was smaller and softer than normal. The head of the epididymis was enlarged and had a swelling on its upper external aspect which on incision allowed escape of a little limpid fluid and a second spherical body identical to the first. The head of the epididymis presented numerous small cysts involving predominantly the back of the upper pole of the epididymis one of the cysts was nearly pedunculated as it was free from the epididymal surface for about three-fourths of its circumference. Orchiepididymectomy was performed and recovery followed.

There is no doubt that the nucleus of these free bodies was formed from small epididymal cysts. This is proved by (1) the histologic finding of lacunar spaces grouped in the center of the free bodies and filled with amorphous substance similar to that found in the pedunculated subepididymal cyst; (2) the presence of this pedunculated cyst which in time would probably have given rise to the formation of another free body; and (3) the absolute integrity of the vaginal sac of the testicle. The presence of the epididymal cysts may have been due to a gonorrhea incurred by the patient at the age of 18.

The similarly spherical form of the two free bodies, despite the difference in their environmental

conditions demonstrates that eventual mechanical causes depending on the milieu in which the free bodies have developed cannot have any importance in determining their shape. This stands in contradiction to the opinion of some authors who have claimed that the spherical form is the result of the capacity of the bodies to revolve freely in the ambient cavity.

The structure of the free bodies consisting exclusively of fibrillary tissue arranged in concentric layers with complete absence of any cellular elements could constitute a proof in favor of the extracellular origin of the fibrilla, whether they are considered as a differentiation of a primarily amorphous fundamen- tal substance or as a process of fibrous evolution of the proteins contained in the ambient fluid. It might be that the cells generating the fibrilla have been destroyed secondarily or completely trans- formed into fibrils as the nutritional condition of the free body deteriorated but in such a case it would be necessary to admit that at the time of operation the free body had already exhausted its capacity of further increasing in volume.

RICHARD KEMER, M.D.

MISCELLANEOUS

Nonparasitic Lymphuria; Clinical and Therapeutic Study of a Case (Linfuria non parasitaria, considerazioni cliniche e terapeutiche a proposito di un caso) E. MALAN and G. AREZZI. *Boll. Mem. Soc. Pneumot. chir.*, 1947 17 513.

A 13 year old girl sustained a severe contusion of her right knee at the age of 8 years and since that time had pain, swelling, and contracture of the involved articulation. In course of time the condition became complicated by febrile episodes, dysuria, increased frequency of urination, and emission of turbid urine containing gelatinous pinkish material. The urine had a specific gravity of 1.022, acid reaction and on standing formed 3 layers, the lowest layer contained epithelial and pus cells and fat globules, the central layer had a milky appearance and the uppermost layer was formed of a white gelulum. Each episode of ischuria was concurrent with severe pain in the right knee. Repeated search for filaria in the blood and urine gave negative results. While intravenous urography failed to reveal any pathology, ascending pyelography visualized on the right side the perirenal

lymphatic network, the penureteral lymphatic plexus and the lumbar lymphatic duct.

The right kidney was exposed and stripped of perirenal tissue to isolate connections with the lymphatic system. Following the operation an extensive edema developed in the right gluteal and lumbar regions and in the right lower extremity. After a series of intravenous injections of gonacrine the condition was found to be improved and the urine cleared.

There was no evidence of a congenital neoplastic syphilitic or tuberculous origin of lymphuria. Probably subacute lymphangitis following the trauma of the knee produced stasis and caused the formation of fistulas between the lymph vessels and the right kidney.

JOSEPH K. NARAZ, M.D.

Control of Urinary Tuberculosis. GEORGE E. SLOTKIN. *J. Urol.*, Balt. 1947 58 464.

A preliminary report is made of the use of streptomycin in combination with chaulmoogra oil in the treatment of inoperable or bilateral renal tuberculosis. The report includes 6 active cases of inoperable and bilateral renal tuberculosis treated since January 1, 1947 and also in vitro studies and studies of guinea pig inoculations.

The author made use of the *Mycobacterium phlei* for the studies in vitro. Broth suspensions of this organism were inoculated into various dilutions of chaulmoogra oil and streptomycin. It was clear that exposure to chaulmoogra oil caused considerable inhibition of growth and that the *Mycobacterium phlei* is made more sensitive to streptomycin by exposure to chaulmoogra oil for a period of 24 hours. Inoculation of 7 guinea pigs with tuberculosis was done. 3 received no treatment and upon autopsy showed marked involvement with the disease. One pig treated with streptomycin alone, and a treated pig with streptomycin and chaulmoogra oil showed no evidence of tuberculosis.

A total of 6 patients with bilateral inoperable renal tuberculosis received treatment with chaulmoogra oil and streptomycin for 30 days. All of these patients had proved bilateral renal tuberculosis, in most cases with involvement of the lower urinary tract. In every case the disease was arrested by treatment, and guinea pig inoculations following therapy revealed no evidence of tuberculosis. In view of these striking results further investigation is planned by the author.

JOSEPH E. MAURER, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Osteofibroma or Circumscribed Fibrous Cystic Osteodystrophy (Osteofibroma or osteodystrophia fibrosa circumscripta)? ERZO DE MARCONI. *Chir. urol. med.* 1947 51: 51

The roentgenologic diagnosis of circumscribed cystic fibrous osteitis, solitary bone cysts, and giant cell tumors offers great difficulties. The term "fibrous osteitis" includes Recklinghausen's generalized fibrocystic osteitis, circumscribed fibrous cystic osteitis, and Paget's disease. Difficulties may be encountered in the differential diagnosis between fibrous osteitis and giant cell tumors.

A 20 year old woman was admitted to the hospital with complaint of pain in the left hip. Five months prior to admission she sustained a slight injury to her left hip and 2 months later the pain occurred.

Roentgenograms revealed a single cyst of the size of a hen's egg in the left femoral neck. The lower border of the cyst apparently broke through the cortex of the femoral neck.

Absence of periosteal reaction and of sequestra and also the normal temperature excluded pyogenic osteomyelitis. Tuberculosis, syphilis, and echinococcus disease also could be excluded. The integrity of all other bones favored elimination of Recklinghausen's disease, Paget's osteitis, and Brodie's abscess. A bone cyst, giant cell tumor and circumscribed fibrocystic osteitis were considered. Biopsy established the diagnosis of a fibroma.

During the entire year following the operation no reparative processes could be detected and therefore a bone graft from the tibia was inserted. Two years later the patient's gait was normal, she had no pain and x ray studies showed restitution of the bone. The histologic examination of a specimen taken at the second operation suggested the diagnosis of an osteofibroma, a relatively rare condition.

JOSEPH K. NARAY, M.D.

Ollier's Disease and Its Relation to Other Forms of Chondrodysplasia. A. LANGENSKIÖLD. *Acta orthop. scand.*, 1947 17: 95.

About 50 years ago Ollier called attention to a growth disturbance associated with unilateral thickening of the ends of long tubular bones which he called dyschondroplasia. The author adds 3 cases which correspond with the condition originally described by Ollier but are classified as chondrodysplasia. The first case was that of a 6 year old boy whose right leg showed a shortening of 6 cm. The roentgenograms showed areas of irregular densities in the ilium, thickening of the femur and coxa vara. The upper extremities and the tarsal bones showed similar abnormalities. The second case was that of a 56 year old woman who was first examined at the age

of 4 and followed up until the present date. This patient showed multiple lesions in the pelvis and in the long tubular bones. The right leg was about 12 cm. shorter than the left. There was an exostosis on the distal portion of the right femur and there were hemangiomas of the skin.

This condition appearing in the literature under different and various names, was accepted as one with a benign course. One investigator however claimed that the cartilaginous foci in Ollier's disease did not necessarily stop growing when the individual ceased to grow but continued to increase in size. They were therefore "potentially malignant lesions."

By means of schematic drawings and by roentgenograms it is demonstrated how these cartilaginous lesions appear in the metaphyseal regions. Portions of the epiphyseal plate are separated but continue to proliferate and move away proximally to this plate. This may occur near the cortex or more toward the middle portion of the epiphyseal plate. Ranvier pointed out that the osteogenic layer of the perosteum probably originates in the undifferentiated cells primarily lying within the epiphyseal cartilage.

The differential diagnosis between Ollier's disease and enchondromatosis is based on the fact that in the latter the cartilaginous foci are round or oval and are potentially malignant, while in the former the cartilaginous foci are elongated because of the appositional type of growth inherent in cartilage originating from the epiphyseal plate. Although most observers are inclined to separate tumor distinctly from all other growth processes, the fact cannot be disregarded that there are stages of transition between hyperplasia and autonomous tumors.

Most workers consider Ollier's disease, enchondromatosis and multiple cartilaginous exostoses under the common heading of chondrodysplasia since features of all three conditions may be found in the same individual.

GROENK L. RANIER, M.D.

Osteochondromatoma of the Sternum: Use of Tantalum Plate as a Prosthesis. R. AARVOLD. *Arch. Surg.* 1947 55: 681

A 41 year old farmer was admitted to the hospital because of a tumor of the sternum which grew in 18 months from 5 cm. in diameter to a mass which measured 10 by 11 by 13.5 cm. The tumor the underlying sternum and portions of the ribs were removed *in toto*. A tantalum plate 0.032 cm. in thickness was used to cover the defect.

By using this plate paradoxical respiration was prevented in the immediate postoperative period. On the seventh postoperative day a considerable amount of fluid was observed in both pleural cavities. On the tenth day serosanguinous fluid escaped from the distal portion of the incision. On the fifteenth day edema and tenderness of the left calf developed. This condition improved after ligation

of the left femoral vein. Serosanguinous drainage continued and the tantalum plate was removed on the sixty-third postoperative day. The soft tissue had sufficiently thickened to prevent paradoxical respiration. The wound healed satisfactorily. The tantalum plate served well as a temporary prosthesis.

GEORGE L. REES, M.D.

Retroposition of the Vertebrae as an Early Sign of Tuberculous Spondylitis of the Lumbar Spine.
LAUS HAAKSTAM. *Acta orthop scand* 1947 17 31

Instability between the vertebrae of the lumbar spine may arise at an early clinical state—with tuberculous spondylitis as well as with disc degeneration. In the roentgenogram a retroposition might occur before any tuberculous changes in the vertebrae themselves are visible. Such a picture favors the belief that the process is to be found in either vertebra adjacent to the injured disc.

A normal disc fastens the adjacent vertebrae very rigidly to each other and parallel displacements between the vertebrae do not arise in such cases. In stability occurs when the discs are degenerated and retroposition arises before the injured disc is entirely destroyed. After the disc substance is entirely destroyed and has perhaps been replaced by unspicific connective tissue and the surfaces of the vertebrae almost seem to touch each other very little if any retroposition is visible any longer.

In one of the authors' cases the roentgenogram showed osteoporosis and retroposition but no destruction of any vertebrae or discs. The author described 4 cases which showed that retroposition occurred in connection with tuberculous destruction of the vertebrae and the discs of the lumbar spine before the body of the vertebra had collapsed.

Tuberculous spondylitis may develop just as any other kind of tuberculosis of the bones does without any changes that can be visualized in the roentgenograms. Rather large tuberculous vertebral foci have been found at autopsy although the roentgenograms were negative.

In 1943 Severin found retroposition in about half the number of 266 patients showing signs of degeneration of the intervertebral discs. This retroposition occurs in the cranial as well as in the caudal part of the lumbar spine. Diagrammatic sketches were made showing the degree of retroposition in several of the cases.

C. FRANK GÖRANSSON, M.D.

Giant Cell Tumor of the Lumbar Spine (Tumore a micropilares del rachide lombare) G. CORRAZCHI. *Rev. medica* 1947 31 139.

Giant cell tumors are most frequently found in the metaphyses and epiphyses of long bones and in the upper jaw but rarely in the spine.

The author observed a giant cell tumor in a 35 year old patient. The tumor located in the third lumbar vertebra, began causing pain along the lower end of the spine 7 years prior to admission to the hospital. Roentgenograms showed a deformity of the involved vertebra with slightly narrowed but

preserved intervertebral spaces. A large shadow was contiguous with the right margin of the affected bone. The tumor was removed and the patient made an uneventful recovery.

The diagnosis is usually based on x ray findings which show characteristic changes in the structure of the involved bone. Contrary to the giant cell tumor Pott's disease shows arthrotropic tendencies. Sarcoma usually does not invade the discs, but it affects the bodies of one or more vertebrae and produces a more or less circumscribed shadow with irregular outlines. Chondroma has a spotted appearance minute shadows intermingled with light areas.

A complete removal of the tumor should not be attempted in each instance because radical operation is connected with a very high mortality. A partial removal of the tumor followed by the application of a cast, as in the author's case, may be sufficient.

JOSEPH K. NARAY, M.D.

Derangements of the Knee. PAUL R. LIPKOWSKI and MELVIN HENRIKSSON. *J Am Med Ass.* 1947 135 837.

The cases in which arthroscopy of the knee has been performed at the Mayo Clinic for derangements of the meniscus through 1944 were reviewed in two series. The first series included records of patients who had suffered internal derangements of the knee to and including 1933. The second series included cases in which arthroscopy was performed in the years 1934 through 1944. Arthroscopy was carried out 664 times for 655 patients who had the condition in question.

The diagnosis of meniscal injuries or abnormalities can be established best by the careful taking of a history in which locking of the knee joint followed by pain and swelling is elicited. This triad was present in 70 per cent of the patients.

In many cases of injury to the meniscus there are associated injuries to the ligaments or of the articulating surface of the patella. In this group of patients the results of surgical treatment are likely to be considerably worse than among those patients whose injury is confined to the semilunar cartilages. In the more recent of the two series the results of excision of the torn portion of the cartilage and the results of excision of the entire cartilage were essentially the same.

SURGERY OF THE BONES JOINTS MUSCLES TENDONS, ETC

Fundamental Concepts and Treatment of Volkman's Completely Developed Contracture (Conceptos fundamentales en el tratamiento del Volkman completamente constituido) PEDRO V. FERNANDEZ. *Rev. Soc. Cir. Uruguay* 1947 18 202.

The complete evolution of Volkman's contracture may require several years and it is a grave error to undertake treatment of the condition before termination of the process.

The motility of the fingers is preserved when the wrist is kept in flexion but if the wrist is extended extension of the fingers becomes impossible because of the shortening of the flexor muscles. Disturbance of balance between the osseous and the musculo-tendinous systems of the involved extremity is responsible for the inability of the patient to extend his wrist. It follows that either the bones must be shortened or the muscles and tendons must be lengthened. The author favors the first procedure. Delayed union the formation of pseudarthrosis deviation of fragments, angulated callus, and radioulnar synostosis usually can be avoided with the proper technique.

The author favors atypical resection of the wrist and arthrodesis because the resulting impairment of the function of the wrist is minimal. The operation is indicated in cases with considerable flexion of the hand and marked shortening of the forearm.

If the shortening of the forearm and the flexion are moderate a partial resection of the radius and the ulna is indicated.

It should be remembered that lowering of the insertion of the epitrochlear group of muscles causes a diminution of their tone.

Elongation of tendons is a technically difficult procedure. It is necessary to suture 21 tendons. In exceptional cases tenotomy of the flexors proper of the wrist may be necessary to supplement other therapeutic procedures.

In many instances a combination of several procedures, such as ankylosis of the wrist and interphalangeal articulations, tenotomies of several muscles, resection of the elbow and reinsertion of the epitrochlear group of muscles may be necessary.

JOSEPH K. KARAT, M.D.

Reparative Surgery of Severed Tendons and Nerves of the Hand HANS BIAT, *Surg. Clin. N. America*, 1947 27 1474.

The author believes that primary repair of injured tendons and nerves may properly be done in clean wounds up to 6 hours after the injury. His technique consists of a thorough cleansing with soap and water and alcohol. The operation is done under general anesthesia, and a blood pressure cuff is placed on the extremity for a tourniquet. The operation includes an excision of the wound edges, and gentle handling of the nerves and tendons is stressed.

In exploring the wound one should first locate the nerves, then the arteries and veins, and finally the tendons. It is usually necessary to enlarge the wound to find the proximal tendon ends, and the distal ends can usually be brought into the wound by moving the fingers in the appropriate direction. One should respect the tendon ends back to healthy tissue before repair of the tendon by any of the commonly recommended tendon suture methods. In injuries of the palms the proximal end of the tendon is usually retracted so far that a small incision must be made above the wrist to locate it. The tendon is then pulled into the original wound by means of a tem-

porary silk suture threaded on a probe. If both the sublimis and the profundus tendons are injured within the sheath, only the profundus should be repaired, as it is not proper to have two sutured tendons within the same sheath where they would become adherent.

Secondary suture is indicated when primary suture has failed or in wounds in which the 6 hour time limit has passed or contamination or unhealthy tissue is present. The procedure is difficult because of the adhesions which have formed and the retraction of the tendon ends. It is often necessary to graft tendon material to cover defects. One should not do tendon repairs in the presence of stiff joints.

The difficulties of secondary suture are much more serious if a primary suture has been done and failed. This is one of the reasons why one should not attempt primary suture unless conditions are definitely favorable.

One should do a secondary suture through enlarged incisions so that adequate exposure is obtained. All scar tissue should be excised, and devitalized unhealthy tissue should be debrided. Sometimes fat grafts obtained in the thigh must be placed between structures when dense scar tissues make a gliding surface otherwise unobtainable.

The after treatment of these tendon sutures depends upon a proper understanding of the two stages of tendon healing. The first the proliferative stage lasts a week, during which connective tissue callus unites the tendon ends. No motion should be permitted during this period, as early motion favors adhesion formation. The best splint is made of a molded plaster. The author removes this splint in 4-6 weeks, removes the sutures, and begins gentle motion under water. The splint is discarded in 3 weeks, and active and passive exercises with massage and heat are begun. Occupational therapy is useful.

Appropriate diagrams and a few illustrative cases are presented. NEWTON C. MEAD, M.D.

Contribution to the Technique in Fusion Operations on the Spine. ARTHUR BRAD, *Acta orthop scand* 1947 7.

The results of fusion operations on the spine were judged clinically by the degree of fixation attained, and roentgenologically by the quantity of newly formed bone around the transplanted graft. The author summarizes the results of 48 operations for fusion of the spine by various methods for tuberculosis spondylitis, scoliosis, etc.

It was easier to judge the results in the lumbar spine than in the thoracic area. In the thoracic area it is difficult to observe the space between the spinous processes because of the position of the ribs. The author believes there is evidence both experimental and clinical, that every transplanted bone, whether large or small, thick or thin, will die. After transplantation there is no growth of osteoblasts from the haversian canals and the calcium in the necrotic grafts plays no role as regards the regeneration of the bone. The necrotic graft is gradually replaced by

living bone through substitution processes which take a longer time according to the size of the transplanted bones. Such necrotic massive grafts which have lost the cells and the structure of living bone, and which for the most part consist only of lime will give to the roentgenogram some suggestion of solidity and strength but represent, in the literal sense of the term, a white sepulchre. Therefore if the grafts disappear rapidly and if signs of the formation of new bone appear the prognosis is good.

The Albee method of spinal fusion was used at first, but this was abandoned subsequently because of the difficulty in getting the graft to hold on to the spinous process of the healthy vertebrae above and below. Six Albee transplantations were studied. Six months later not a single case was found to have signs of new formation of bone and clinical fixation was seen in only two of the cases. In subsequent months the remaining cases showed undoubted new formation of bone though one case was listed as doubtful. When the Albee operation was modified by using a thin instead of a thick graft from the tibia the result was apparently worse. The result was found to be a little better in cases in which two thin grafts were inserted into grooves chiselled in the base of the spinous process after removing the outer most parts of the spines. In this last series of cases and in a few of these there was new formation of bone. The author maintains that the use of thick transplants hinders the building up of living bone tissue between the arches. Orell's fixation operation in cases of tuberculous spondylitis was discussed.

A procedure was adopted which consisted primarily in providing a space over the arches where the new formation of bone may proceed unhindered. Secondly this space is filled with the elements from which the new bone tissue is to develop. A semi-flexible slice of bone covered with periosteum is removed from the tibia and is placed towards the muscles which are loosened from the spinous process and back into place over the grafts by means of small pieces of bone likewise taken from the tibia, which are stretched out between the spinous processes and the semiflexible piece of bone periosteum. The author further modified this procedure by filling the space between the slice of bone (which keeps the muscles out) and the spinous process with bone shavings from the tibia.

The entire operation is performed under local anesthesia. It is simple and it can be performed in cases of the most extreme deformity of the spine. The after treatment is of short duration due to rapid setting in of the process of substitution and to active regeneration of the bone. As strain on the spine at an early point of time does not disturb but rather promotes this process the patients can get up after 6 weeks. The duration of the subsequent treatment with a plaster corset will be comparatively short but varies for each individual and is dependent on the degree of regeneration found on x ray examination.

A total of 19 operations was performed by this method. Thirteen cases were analyzed in 11 of these new formation of solid bridges of bone over the arches was found 6 months after the operation. Follow up studies in 6 of the 19 patients were in sufficient for discussion.

C. FRED GOEDHOUT, M.D.

Joint Mobilizing Operations on the Hip, Knee, and Shoulder for Complications following Trauma
PAUL H. HARMON *Am J Surg*, 1947 74 598

Present degenerative joint disease follows most major or repeated minor trauma especially in weight bearing joints. In 35 cases of such hip joint arthritis the condition is thought to have been precipitated by trauma. Cup arthroplasty was done in these selected cases to increase the range of motion and decrease attendant pain. Advanced degeneration of articular cartilage contraindicates the arthroplasty as does antecedent infection in the hip joint.

Plastic cups used in the early cases tended to wear thin or crack. A new type of cup turned from a solid block of plastic to a uniform three-sixteenths of an inch has proved satisfactory. A minimum of reshaping of the femoral head other than removal of osteophytes and making the major reconstruction that of the acetabulum helps preserve the integrity of the reflected joint capsule and is advised by this author.

Excystectomy alone is done in cases in which inspection shows fairly good articular cartilage, and motion is improved by the removal of osteophytes from the acetabulum and femoral head.

Buck's extension with an internal rotator strap is the only apparatus used postoperatively. Adduction of the leg is avoided. Physical therapy is begun at 3½ weeks and nonweight bearing crutch walking from 4 to 8 months, depending upon the extent of the surgery.

In from 5 to 7 years after operation, 61 per cent of the whole group showed good results i.e. an increase in motion and freedom from pain.

The subject of degenerative changes in the knee summarized. A modification of the Magnusson technique for patelloplasty was carried out in 37 cases and after a period of from 8 to 3 years the results in 35 cases were classed as good. The patients had little or no pain and at least 130 degrees of active and passive motion.

Six cases of arthritis of the head of the humerus are reported. In 2 of these partial resection of the humeral head was carried out and in 4, osteophytes were removed from the posterior glenoid rim. Five of these patients showed an improved range of pain less motion.

FRANCIS E. BRENNER, M.D.

Epiphyseolysis Capitis Femoris Treated by Drill
Ing. SVEN KLOER. *Acta orthop scand*, 1947 17 81
Since 1939 one group of patients with slipped femoral capital epiphysis was treated by drilling of

the femoral head and another group afflicted with the same disease was treated by fixation of the slipped femoral capital epiphysis by means of a nail.

The first group consisted of 4 female and 11 male patients between the ages of 11 and 18 years who had early to moderate slipping. Drilling was employed to accomplish fusion between the femoral head and neck. Patients with marked slipping (exceeding one-third of the epiphyseal diameter) were treated by osteotomy and were not included in this series. Patients with acute slipping were also excluded. The symptoms of pain and limp had persisted for from 5 to 50 weeks prior to entry into the hospital.

All patients were initially treated with traction on the extremity for 4 weeks, one tenth of the weight of the patient being used as traction pull. Then three channels were drilled through the femoral neck into the capital epiphysis with a 3 mm. drill. Post-operatively the patients were confined to bed for from 4 to 8 weeks and were then allowed to ambulate with the help of crutches. No weight bearing of the affected extremity was permitted until fusion between the capital epiphysis and neck was visualized on the roentgenogram.

Bony fusion was obtained in all cases. An excellent result was observed in 11 cases—there were no subjective complaints, there was less than one third loss of motion in the hip joint and the patients were able to do the same work as prior to the onset of symptoms. There were good results in 8 cases and poor results in 3 patients.

Traction did not seem to change the position of the slipped epiphysis. Changes in the femoral neck disappeared soon after drilling of the femoral neck and head.

Drilling has the disadvantage of a prolonged post-operative course lasting from 9 to 12 months. Walking without weight bearing on the affected extremity may cause slipping of the femoral capital epiphysis of the normal side.

With internal fixation by means of the Smith Petersen nail, full weight bearing is possible after from 9 to 12 weeks. Fusion of the femoral capital epiphysis occurred at about 12 weeks without any evidence of secondary slipping of the epiphysis.

GEORGE L. RENZI, M.D.

Indications and Technique of Surgical Treatment of Post Traumatic Genu Recurvatum (Indicazioni tecniche nella cura chirurgica del ginocchio recurvato post traumatico) LEONARDO GUI *Chir. org. modern.* 947 3 53.

Observations on 5 patients with post traumatic genu recurvatum led the author to believe that Lange's simple osteotomy furnishes very satisfactory results if the operation is performed by a competent orthopedic surgeon. The main objection to the operation, namely the difficulty in estimating the degree of angulation to be employed after the operation can be overcome by the following technique.

Roentgen pictures are taken in lateral direction with the knee in hyperextension. An incision from 8

to 10 cm. is made on the lateral aspect of the lower third of the thigh and a linear osteotomy perpendicular to the axis of the femur, is done approximately 4 to 5 cm. above the condyles. Roentgenograms are taken in lateral direction. A comparison with films taken before the operation permits a calculation of the necessary degree of angulation. Deviations, if any in regard to varus or valgus positions, or rotation are corrected. The wound is sutured and a cast is applied. After a month the cast is replaced by a new one. The patient is kept in a cast for from 2 to 4 months according to the evidence of consolidation of the fragments. Bier's hyperemia massage (faradic current and mechanotherapy) are employed.

The main indication for the operation is given by a fracture through the diaphysis of the femur with angulation in the sagittal plane. An osteotomy of a fractured tibia should never be done because of the danger of pseudarthrosis. JOSEPH K. NARAY, M.D.

Observations on the Management of Suppurative Arthritis of the Knee Joint. OSCAR P. HANSTON, *J. Am. J. Surg.* 947 74 631

Significant changes in the management of suppurative arthritis of the knee developed out of the experiences in the Mediterranean Theater during World War II. Knee joint wounds are serious not only because of their threat to normal function but also because of their potential threat to life and limb. The death and amputation rates from knee joint sepsis in World War I were high and so great was the respect of the French for the sequelae of this injury that they employed primary resection prophylactically in severely damaged joints and secondary resection when the suppurative arthritis did not respond promptly to drainage and immobilization.

Suppurative arthritis is potential in every penetrating wound of the knee joint, but sepsis is established only when, after several days, there is decomposition of the tissues and formation of pus. Management begins with wide arthrotomy for complete inspection of the joint, removal of all foreign bodies and devitalized tissues, thorough irrigation of the joint, and closure of the synovia. Complete immobilization in a plaster spica or a Tobruk splint plus local and systemic penicillin therapy completed the regimen that held the occurrence of sepsis to a low rate. Failure through loss of tissue or time lag to close the synovia resulted in slow healing and disproportionately great scarring and limitation of motion. Eventually for this reason, closure was done 24 hours or more later. It was observed that the incidence of established suppurative arthritis varied with the extent of damage to the joint and the adequacy of excisional surgery. Resection of the joint was not considered even though prolonged suppuration with joint destruction was likely.

Therapy of an established suppurative process consisted of wide parapatellar incisions for continuous drainage, immobilization, and administration of antibiotics. Slow destruction of the joint and concurrent



Fig. 1

Fig. 1. Shows the swollen joint and the granulating wound, with pus draining from the opening in the center as they appeared in the operating room on October 21, 1944, (Courtesy of *American Journal of Surgery*)

Fig. 2. Photograph of the medial arthrotomy incision. Inflamed synovial membrane and the partially necrotic cartilage of the comminuted patella are poorly visualized.

chronic sepsis in many instances suggested the need for a more satisfactory mode of treatment. Continuous drainage incisions are inefficient in preventing bacterial cartilage digestion and impair the antitoxin continues as long as any devitalized cartilage remains and secondary invaders readily gain foothold where the articular cartilage nutrition is impaired. It appeared then that continuous drainage of the knee joint was contraindicated and therapy of established suppurative arthritis should be based on

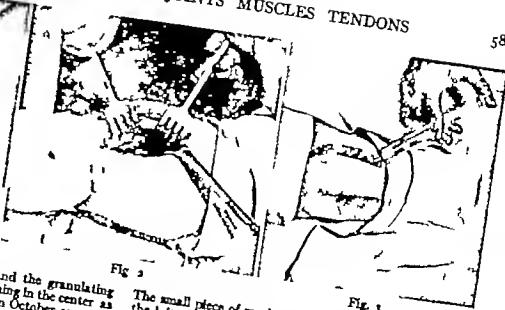


Fig. 2

The small piece of woollen cloth is shown on the gauze at the left of the incision. The quadriceps pouch was filled with a coagulated fibrinous exudate.

Fig. 3. Following removal of the patella and cleansing of the joint, the synovial membrane of the arthrotomy incision and the defect in the old wound were sutured (plus a few sutures in the tendon). The joint was filled with penicillin.

Fig. 3

the same principles as the management of potential infection

The revised therapy provided that, regardless of the time lag or duration of sepsis the joint cavity must be exposed fully and all foreign bodies and devitalized tissue excised. Clots and exudate are removed, and the synovia closed if necessary are replaced graft or rotated skin flap. Penicillin solution is instilled into the joint, thorough immobilization provided and systemic penicillin therapy instituted. The reaccumulation of joint fluid is aspirated through



Fig. 4



Fig. 5

Fig. 4. The fragments of patella, some of the fibrinous exudate and the bit of cloth removed from the joint.

Fig. 5. The skin has been sutured and the joint re-splinted (October 26)



Fig. 6

Fig. 6. Demonstrates the range of active painless motion of the knee on November 17. Quadriceps power was sufficient to extend the knee but a hand held the foot for the photograph.

the windowed cast with the instillation of penicillin, at 24 to 48 hour intervals. When the danger of continuing sepsis is past (5 to 7 days) the remaining soft parts are sutured. When they are sufficiently healed or at about 5 weeks postarthrotomy a Thomas splint with Pierson attachment replaces the plaster spica, and passive motion is gradually increased.

This regimen was most successful in reducing morbidity and securing maximum function. When the tissue loss was so great that subsequent joint function was precluded, sepsis was eliminated and the optimum result was obtained by joint resection. The bone ends were held in apposition firmly to eliminate dead space.

Excellent case reports demonstrate the effectiveness of penicillin only in the presence of adequate surgery with removal of all devitalized tissue, and the possibility of salvaging a joint if intra-articular foci are excised before the digestion of undamaged articular cartilage begins. One case of knee joint resection in the face of severe sepsis was resorted to instead of amputation (one leg was already amputated) in order to save life.

It is reasonable to suppose that blood borne suppurative arthritis of the knee not responding to aspiration immobilization, and antibiotics, would like wise yield to excision of sepsis-devitalized tissue, exudate and hematoma, with closure of the synovia and the regimen so satisfactorily evolved in the handling of these war wounded joints.

FRANCIS E. DEERBECKER, M.D.

FRACTURES AND DISLOCATIONS

Use of Internal Fixation in Compound Fractures.
BA NARA B. SINGH. *Am J S* 2: 1947 74 697

The author has made an analysis of compound fractures of the shaft of the femur and tibia which were treated on a fracture service during the years 1935 through 1942. There were no cases of nonunion among patients in whom the fixation was rigid. There were minor disasters such as broken plates and refractures, but none that jeopardized life or limb. (The metal itself does not introduce bacteria nor does it provide a medium for their growth.) An adequate length of plate and one or more transfixation screws to prevent torsion strain were necessary. Rigidity is therefore, the first principle underlying the use of internal fixation in the treatment of compound fractures.

The initial treatment of compound wounds is surgical débridement and copious lavage with water or saline. From 1935 through 1942 all wounds were left open, with sutures placed but not tied. In 1945 some of the wounds were closed initially.

The end-results in 15 fractures treated by internal fixation and initial closure are tabulated. The use of penicillin and other antibiotics permits the surgeon to sleep better at night, but replaces neither careful surgery nor mechanical principles. Amputation was necessary in but one case due to inadequate débridement and tight closure. The follow-up results for a

period of 5 years or more are shown. Among 37 cases of compound fracture there were 2 deaths due to other causes, and 3 amputations in patients who could not be followed.

The late results in 14 cases of war injuries to the femur and tibia are included. Operations were performed at intervals varying from 3 days to 6 weeks after wounding. There were no deaths, no amputations, and no case in which there was spread of infection or nonunion. All wounds were solidly healed. Five men with compound fractures of the tibia are employed and 3 others have limitation of knee motion.

The author believes that certain compound fractures of the lower extremity should be plated and emphasizes the necessity for correct surgical treatment of the wound without initial skin closure followed by adequate suture under anesthesia after a period of 5 days and rigid mechanical fixation of the fracture.

RICHARD J. BARNETT, Jr. M.D.

Cortical Fixation (Ober Corticalbohrung). T. JOHNS.
Brit J Chir 1947 34 332.

Because of the danger of fat embolism associated with fixation material passing through the bone marrow the author has attempted to provide fracture fixation by means of support placed in the cortex without injury to the marrow. The best results followed the use of thin rectangular metal plates which were driven into a slot made in the cortex by a circular saw. The fracture was freely exposed, reduced, and then held in position by elevators or clamps while a slot was cut in the longitudinal axis of the fragments. In order that the metal plate could be more easily driven into the slot, its lower edge was beveled. For firmer fixation the thickness of the plate was slightly greater than that of the saw and its flat surfaces were grooved (Fig. 1). It is surprising how firmly a fracture is held by this simple method both with respect to transverse shearing movements and to rotation.

The author has used the method in 5 cases. In one case of fracture of both bones of the forearm the plates became loose and worked out of the slots so that a pseudoarthrosis was present at the end of 5 months. Union was obtained by a bone grafting operation. This result might have been avoided if the plates had been held in place for a longer time by means of wires encircling the bones. In the future the author plans to fix the plates by the use of wires when prolonged fixation appears necessary. For the larger bones (femur, humerus, tibia) or even 3 plates may be advisable. By placing the saw cuts parallel or at an angle to one another one might achieve maximum stability in one or in several directions (Fig. 2).

Experiments indicate that this method of cortical fixation prevents transverse and rotational movements, but it has certain disadvantages with respect to operative damage to the periosteum and with respect to bending strains.

JONAS L. LUNDQVIST, M.D.

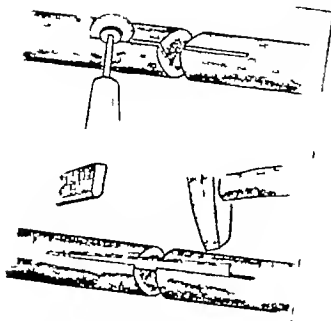


Fig 1 (Johner)

The Recurrent Dislocation of the Shoulder (Ueber die habituelle Schulterverletzung) ARNOVON HELLENHANS
Ann. chir. gymn. 1947 36 Supp. 3.

There are certain anatomical changes which predispose a shoulder joint to recurrent dislocation and which are found following the first dislocation. There may be a general stretching of the entire capsule which makes it possible for the humeral head to dislocate intracapsularly. The capsule may show a pocketlike herniation or there may be an actual tear in the capsule. Perthes was first to call attention to the frequent occurrence of a capsular defect in the region of the labrum glenoidale. Hybenette found a large number of cases with a slit type of tear about 2 c.c. long in the anterosuperior portion of the capsule underneath the subscapularis muscle. Less frequently there was a separation of the entire labrum glenoidale. Not infrequently there was a tear of the infraspinatus and supraspinatus muscles at the greater tubercle associated with a tear in the capsule.

Bankart and Gray stated that a tear of the labrum glenoidale alone was the cause of recurrent dislocation of the shoulder. Laugenakjold supported this view and added that when the tear occurred in the capsule without injuring the labrum healing usually occurred and recurrent dislocation never resulted.

Often changes were observed in the humeral head. There was either a fracture of the greater tubercle or there was a wedge shaped defect in the posterolateral aspect of the humeral head (en hachette). Occasionally the mechanism of the injury predetermined whether there would be a recurrent or simple type of dislocation. Bankart found that a fall directly on the shoulder or on the elbow pushing the humeral head forward usually injured the labrum glenoidale and resulted in a recurrent type of dislocation.



Fig 2 (Johner)

ation. An injury in which the head was levered out of the glenoid fossa caused a simple type of dislocation.

A congenitally relaxed capsule inco-ordination of the shoulder muscles, and abnormally short pectoralis or latissimus dorsi muscles were cited as factors predisposing to recurrent dislocation of the shoulder joint. It is significant that dislocations of the shoulder scapular joint occur frequently in young individuals and epileptics.

Many workers advocate early mobilization and just as many advise early mobilization as the best treatment of acute dislocation of the shoulder.

There are more than 30 operative procedures recommended for the repair of recurrent dislocation of the shoulder joint. The conservative measures have only historical significance. There are two main groups of operations: (1) the arthrodesing operations which have little practical value and (2) the operations in which the joint components are preserved. Operations on the capsule and adjacent muscles include capsulorrhaphy without opening of the joint and reinforcement of the capsule with fascial free fascia lata transplantation and transfer of tibial periosteum for reinforcement of capsule defects. Magnusson uses portions of the subscapularis to reinforce the shoulder capsule. Repair of the labrum glenoidale is advocated by Bankart.

Clairmont and Ehrlich introduced a repair which portions of the deltoid muscle are placed underneath the capsule and sutured posteriorly in the lateral compartment of the axilla. There are many modifications of this procedure.

In 1914 Kirschner used a suspension operation the first time by threading a strip of fascia through the humeral head and through the acromioclavicular joint.

In 1927 Carrel used a similar procedure employing the long head of the biceps. Henderson modified the Loeffler operation by using the peroneus longus muscle to suspend the greater tubercle from the acromion.

Heymanovitch threaded the long head of the biceps through a channel that was artificially constructed under the intertubercular canal. He modified this procedure 3 years later (1929) by directing the artificial channel from the distal end of the intertubercular sulcus into the center of the articulating surface of the humeral head. Nicola described the same procedure a few years later without knowing of Heymanovitch's publication. Experiments carried out in rabbits have shown that the transposed tendon deteriorates very quickly and disappears completely in a great many instances. Other workers have used silver wire and silk to suspend the humeral head on the acromion.

Finally there is a group of operations which involve the bones which make up the shoulder joint. Osteotomy of the humerus at the level of the surgical neck is not very successful. Eden Hybenette devised a procedure in which a bone transplant taken from the tibia or the iliac crest is placed anteriorly to the humeroscapular joint. It protrudes medially for a distance of from 1 to 1.5 cm. from the glenoid rim and prevents the humeral head from dislocating anteriorly. The complication most frequently seen following this procedure has been degenerative arthritis. Orell suggested the use of os purum for the anterior bone block.

The best results were obtained by the Bankart operation. Several surgeons used this procedure in 90 cases and reported only 1 recurrence. The Eden Hybenette operation was used in 303 cases by several different surgeons and 3 recurrences were reported. The Heymanovitch-Nicola operation was used in 387 cases with 34 recurrences. The poorest results were obtained by the suspension operation after which recurrences were reported in 33 per cent of the cases.

The author further analyzed 164 operations and illustrated his remarks with roentgenograms, diagrams, arthrograms and detailed tables.

GEORGE I. REISS, M.D.

New Operative Technique for Recurrent Anterior Dislocation of the Shoulder (Nueva técnica operatoria para la luxación recidivante del hombro h. de adelante) ANTONIO BORILLINI *Rev. chir. bra.* 1941, 8, Abr. 947-63

A new method of treating recurrent dislocation of the shoulder is described by the author. A slightly curved incision along the deltopectoral groove or a T-shaped incision, or an incision in the form of an inverted L is employed.

The apex of the coracoid process with attachment of the tendons of the short portion of the biceps, the coracobrachial and the pectoralis minor muscles are separated from the remaining portion of the bone care being taken not to injure the musculocutaneous

nerve or its branches. The detached fragment of the coracoid process is carried underneath the deltoid muscle and is attached by means of catgut sutures to the acromion. The corresponding arm is placed in abduction of from 60 to 70° moderate antelposition and intermediate rotation, to facilitate the procedure.

The arm is immobilized for 30 days and after that treated with heat, massages, and active and passive motion.

The postoperative condition in 3 cases was very satisfactory but the period of observation is too short to allow definite conclusions as to the permanency of the results. JOSEPH K. NARAT, M.D.

Complications of Fractures of the Lower End of the Radius (Complicaciones de las fracturas de la extremidad inferior del radio) JOSÉ BRAVO and DIÁZ-CARRERO. *Ciruj. aperi.* 1941, 4, 117

Of 66 patients with fractures of the lower end of the radius, 10 presented complications: stiffness of the wrist and fingers in 5, compound fractures in 5, fracture-dislocation in 6, aseptic necrosis in 3, and Sudeck's atrophy in 3.

Among the late complications of fractures of the lower end of the radius, the following are mentioned by the author: contractures, recurrent tenosynovitis, neuritis, osseous atrophy, cysts of the bone and aseptic necrosis. JOSEPH K. NARAT, M.D.

Mechanism of Fracture of the Carpal Scaphoid (Mecanismo de fractura del escafoides carpiano) HÉCTOR DAL LAGO. *Rev. As. méd. argen.*, 1941, 6, 103.

The author presents a theory of the mechanism of fracture of the proximal extremity of the scaphoid which is in accord with the anatomic and roentgenographic facts observed in hyperextension of the wrist. He shows that in this movement an arch is formed by the trapezium, trapezoid, scaphoid, semilunar, capitate, and pisiform of which the trapezium constitutes the basic point of support when the hand is in contact with the ground. The concavity of this arch surrounds the os magnum which thus remains suspended and away from the ground being separated from the latter by the entire content of the carpal canal. When a subject falls on the hand in hyperextension, two convergent forces act on the wrist. One starts from the point of support (trapezium) on the ground through the thenar eminence and is transmitted by the vertical column of the trapezium-scaphoid-radius in an upward direction. The other (counter-coup) descends through the radius toward the carpus where it divides into two forces: one that continues through the scaphoid where it meets the ring force and may produce fracture of the bone by simple closure of its frontal angle, and another which continues through the semilunar, os magnum, and third metacarpal. As the scaphoid does not meet with any support above in its external radial portion and the os magnum is not supported from below, a torsion couple is formed which frac-

tures the scaphoid at the point where these two forces come together. The combination of the two actions that of compression and that of torsion clarifies the mechanism of all fractures of the scaphoid no matter where they occur as it explains how the radial or cubital inclination, by changing the point of support of the styloid apophysis on the scaphoid changes the location of the point of torsion of the couple.

The scaphoid may be subjected to various traumatic influences the results of which may be classified as follows (1) fractures from a direct blow (2) indirect fractures (a) from divulsion of the tuberosity through ligamentary action (b) from closure of the frontal or sagittal angle, but it would seem that in opposition to the concepts of Deatott and Delbet the angle that closes is not the sagittal but the frontal, (c) from divergent compression or strangulation of the body of the bone through formation of a torsion couple (author's theory) (d) from opening of the sagittal angle this being the type of fracture that accompanies dislocation of the semi-lunar bone.

RICHARD KREML, M.D.

Injuries to the Hip Joint. Traumatic Dislocations Incurred Chiefly in Jeep Accidents in World War II. MARSHALL R. URSAT. *Am. J. Surg.*, 1947 74 586.

The author's report (the first of a series of three presenting an analysis of 58 hip joint injuries in United States Army hospitals in the European Theatre from 1944 to 1946) concerns 15 cases of simple dislocation of the hip. In one case the dislocation was anterior (obturator) and in 14 cases the dislocations were posterior and most of them were sustained in jeep accidents.

The construction of the jeep plus high speed driving provided almost ideal circumstances for producing dislocated hips in the event of head-on crashes. The low seats require rather acute flexion of the passengers' hips, bringing the knees close to the dash board and the lack of enclosure facilitates their falling out on side or back. The riders' position at the time of accident is nicely correlated with the nature of his injury and illustrated by sketches.

Damage in this series of cases is chiefly to the soft parts of the joint but in post reduction films of good technical quality minor fractures are demonstrable, i.e. incomplete fissures of the posterior acetabular rim or avulsed chips in the line of capsular attachment to the acetabular or trochanteric regions. The probability of damage to the capsular vessels in the latter type of injury is considerable but avascular necrosis of the femoral head did not complicate any of the cases in this group.

These dislocations were recognized and reduced fairly easily by relatively inexperienced surgeons. The Stimson technique was successfully used in half of the cases and is recommended for first attempts to reduce any posterior dislocation. Post reduction traction was employed for from 4 to 8 weeks (about 6 weeks was considered optimum) for joint structure healing. Weight bearing was initiated at from 3

months on although all of these patients had been instructed not to bear weight for a period of 6 months.

At a two year follow up 9 of the 15 patients were located. They are compared with 7 civilian patients from the Massachusetts General Hospital Boston, 1 to 7 years after their injuries. The longer period of traction and delayed nonweight bearing in the military patients produced no results superior to those in the comparable civilian patients who had been treated with much shorter immobilisation and earlier crutch walking.

FRANCES E. BREWSTER, M.D.

Slipped Epiphysis in the Adolescent Hip. A Reconsideration of Open Reduction. PAUL H. MARSH. *J. Bone Surg.* 1948, 30-A, 9.

The results of open reduction in the treatment of minimal degrees of slipping are uniformly good however the results are poor in a large number of cases of severe or complete slipping of the epiphysis. Early reduction of the slipped epiphysis is suggested. Traumatic arthritis is a late secondary result of ischemic necrosis of the capital epiphysis and the cause of most of the poor results in any reduction treatment, open or closed. Gross aseptic necrosis seldom occurs in untreated cases. Many excellent reductions of a displaced epiphysis are followed by necrotic changes. Preservation of the blood supply to the epiphysis is the crux of the problem of treatment. The blood supply to the capital epiphysis of the femur comes from (1) a few small vessels which penetrate the cartilage plate from the neck (2) the vessels in the ligamentum teres and (3) the vessels in the perosteum of the neck. The blood supply of the epiphysis is meager after slipping occurs.

During the last 7 years the author has observed and treated, by various methods 26 patients (33 hips) with slipping of the capital epiphysis. His conclusions are the result of that experience.

The injudicious manipulation in closed reduction and surgical trauma in open reduction have been the sources of most of the difficulty. Closed reduction should be condemned except for gentle manipulation to reduce an acute displacement. In cases in which open reduction is required great care should be taken to preserve both the ligamentum teres and the perosteum on the posterior and inferior surfaces of the neck and the epiphysis should not be entirely detached from the neck in this region. Due to this careful operative consideration the head should survive. If the displacement of the epiphysis is more than 1 cm either downward or posteriorly reduction is necessary. If symptoms have not been present for more than 2 weeks reduction by manipulation may be tried. Often reduction may be accomplished by gentle traction and internal rotation followed by or combined with abduction. If the epiphysis can be reduced easily it should immediately be fixed by a Smith Petersen nail.

The operation is described in detail and the incisions into the hip joint and into the femoral neck are explained. Sufficient bone should be removed.

the anterior and superior aspects of the neck to allow the neck to be easily reduced into the head and care must be taken to avoid tearing or even excessive tension on the posterior and inferior peroneal vessels. After the epiphysis has been re-aligned it is fixed by a Smith Petersen nail. The author has used this method in 8 cases since 1913. In 7 cases an average of 21 months' time has elapsed since operation and in 6 of the 7 patients the results were excellent. The operation is difficult, and the technique is exacting and tedious. Several figures, roentgenograms, photographs of patients, and drawings of the operative technique are included.

RICHARD J. BENOETT, JR., M.D.

The Management of Battle-Incurred Compound Fractures in the Region of the Hip Joint. MASHALL R. UHRY, M.D. *Surgeon* 1947 101:467

This article presents the experience and end-results of treating 29 personally observed battle-incurred fractures in the region of the hip joint, in which the follow-up extended from 6 months to 2 years. It includes a table showing the classification of the hip fractures and associated injuries and operations. A plan of management for wounds in the region of the hip joint is proposed based upon the experience obtained in this series of cases. The treatment should consist of débridement, arthrotomy and exploration of the hip joint, and irrigation if gross suppuration is not present. Primary closure of the joint is performed if loss of substance does not make it impossible. This procedure should be carried out as soon as possible after wounding. Chemotherapy should be used to the limit of its usefulness. This procedure should be carried out even in the presence of sepsis.

The surgeon's judgment must determine the amount of débridement of the tissues. The skin should be left open and closed later by delayed suture, and the extremities should be extended and suspended for from 8 to 12 weeks. Active motion should be begun as early as possible.

Whole blood should be used in liberal amounts, and other supportive measures should be employed in some selected cases after successful secondary suture of the wound. Avascular necrosis of the head of the femur probably increases the susceptibility to infection. When necrosis occurs, the dead bone thus serves as a possible focus of infection.

Associated perforations of the bowel most often lead to pyarthrosis, but associated perforations of the bladder are not responsible for subsequent suppurative arthritis. The prognosis in this type of injury is considerably more favorable if the fracture occurs at or below the intertrochanteric area.

The methods of management employed in the treatment of these cases is described in detail in the treatment of 9 cases. Chemotherapy for septic joints has not been found to be effective without preliminary radical surgery. The author believes that failures of judgment in hip joint surgery have been due to conservatism rather than to overzealous surgery.

RICHARD J. BENOETT, JR., M.D.

The Treatment of Pseudarthrosis of the Femoral Neck (Zur Behandlung der Schenkelhalspseudarthrose) O. SCHÜRER and H. BAUTSCH. *Helv. chir. acta* 1947 14:405.

The advantages of the extra-articular operation in recent fractures of the femoral neck suggested the employment of the same procedure in the treatment of pseudarthrosis in the same location. Eighteen operations were performed by the author on 16 patients. 13 of the patients remaining under observation from 2 to 8 years. The use of the 3 flanged nail was combined in some instances with a bone graft. In such cases the nail was placed cephalad and the apofyseal graft from the fibula close to the distal portion of the femoral neck. The intra-articular location of the graft in the region of the caudal portion of the neck did not provoke any functional disturbances. The broad flanges of the nail may inhibit the advance of new blood vessels from the caudal portion of the neck, and therefore the author prefers to place the nail above and the graft below.

Whenever a bone graft was employed for osteosynthesis the patient was kept in a body cast for a period not exceeding 3 months, but was allowed to walk on crutches.

An osseous union was obtained in all of the patients but one. The functional results were very satisfactory. Only in complicated cases was the nailing combined with a bone graft. Hence, the author is not in a position to discuss the merits of both methods. Two or even three grafts may not be able to prevent a slipping of the united bony fragments, and therefore the use of a nail in addition to the graft seems advantageous.

Necrosis of the femoral head occurred in 6 instances and necessitated removal of the nail.

An extra-articular arthrodesis is employed by the author when the pseudarthrosis is of long duration and the secondary changes are marked.

JOSEPH K. NARAY, M.D.

Brackett Operation for Ununited Fracture of the Neck of the Femur. JOHN C. LYNN and RALPH K. GROOMLEY. *Surgey* 1947 2:89.

The need for careful collection and study of end results obtained with the various operative procedures designed for the restoration of function in ununited fractures of the femoral neck continues. As an aid in this study a well-defined set of criteria should be adopted to standardize the evaluation of end-results by different authors.

At the Mayo Clinic the Brackett operation or the procedure as modified by Magnusson was used in 71 cases of nonunion after fracture of the femoral neck, in the years from 1920 to 1945 inclusive. Good results were obtained in 66.7 per cent of the 63 cases in which evaluation was possible.

Internal fixation by means of beef bone screws, or metallic nails or screws was used in 53 of the 71 cases, and good results were obtained in 35 cases. In 4 of these 55 cases follow-up data were not adequate to allow evaluation.

Proper selection of cases careful operative work, valgus position of the femoral head on the remodeled shaft, and adequate internal fixation are important in this operation.

Treatment of Fractures of the Os Calcis by Open Reduction and Internal Fixation ALFRED H. WHITTAKER. *Am. J. Surg.* 1947 74: 687

The author discusses the anatomy of fractures of the os calcis and the high percentage of resultant permanent partial disabilities. The evolution in the treatment of fractures of the os calcis is discussed and an operation is described whereby open reduction makes possible direct manipulation of the fragments. The author suggests that this realignment of the fragments cannot be carried out by closed reduction because the cortical bone is dislocated and cannot be brought back into place accurately. The author uses a curved medial incision because the interposition of the fragments occurs in this area. It is also on the medial side that displacement of the articular surface of the subtarsal joint can be seen. The abductor hallucis muscle may be avulsed with a fragment of bone. The rotated and interposed fragment of the cortical bone is removed by grasping the tuberosity with bone-holding forceps, the line of the tuber angle restored. Drill holes are made across the line of fracture and screws inserted. The abductor hallucis muscle which is attached to an avulsed fragment is replaced and held by screws or sutures.

The end results show that it has been possible to obtain an anatomic reposition and healing at a normal rate. The first patient operated upon had a severely comminuted fracture with marked displacement and extensive involvement of the subtarsal joint. This patient was walking well at 4 months and at the end of the year presented complete recovery with no disability. Two other patients recently operated upon are walking and have excellent anatomic reposition. Sufficient time has not elapsed in these cases to determine whether or not traumatic arthritis will develop.

RICHARD J. BENNETT JR., M.D.

The Mechanism and Treatment of Fractures of the Calcaneus. Open Reduction with the Use of Cancellous Grafts. IVAR PALMER. *J. Bone Surg.* 1948 30-A: 2

The accepted theory of the mechanism of fractures of the calcaneus is investigated in the light of experience gained in surgical exposure of the fragments. The vertical shearing force which splits the calcaneus and produces only a simple linear fracture presents no difficulty in mechanism or in the treatment of the fracture toward a favorable prognosis. In addition at least 50 per cent of all calcaneal fractures present a further problem—intra-articular involvement—produce a ledge of up to 10 mm. height between the levels of the joint surfaces of the two fragments.

Equally often the upper fragment extended posteriorly to include the upper part of the tuber calcanei and the two portions of the bone gaped posteriorly.

Special roentgenograms are necessary to determine the nature of the fracture and for the selection of special cases requiring open reduction. The opinion of the roentgenologist is necessary in order to judge (1) whether a simple linear or a linear and compression fracture is present, and (2) if comminution and depressed articular fragment and the depth of its depression below the rest of the articular surface.

Transfusion and traction as well as subcutaneous exploration showed that the depressed fragment was firm and stable and could be levered up to restore the continuity of the articular facet. Only a moderate exposure was necessary to accomplish this result when traction was maintained to reduce the lateral block. An iliac bone graft cut to snugly fit the lateral articular defect firmly locks the reduction in place. A plaster boot without transfixing pins maintains the immobilization and nonweight bearing ambulation is permitted several days postoperatively. After a period of 12 weeks gradual weight bearing in a firm shoe with metal arch support is begun.

Twenty three patients so treated were all back at work in from 4 to 8 months after operation and the majority of patients have shown one fourth to one half normal painless pronation supination. In all patients, the shape of the longitudinal arch is the same as that in the uninjured foot. This is in strong contrast to the situation in patients treated conservatively.

FRANCIS E. BRECKENRIDGE, M.D.

ORTHOPEDICS IN GENERAL

Osteoporosis. FULLER ALBRIGHT. *Ann. Int. Med.* 1947 27: 861

The author defines osteoporosis as a disturbance in the metabolism resulting in decreased production of osteoid by the osteoblasts. The uncalcified matrix is termed osteoid. The osteoblasts which lay down the osteoid become enmeshed in it as osteocytes. It is believed that phosphatase or phosphorilase or both, are active in splitting off the inorganic phosphate from organic phosphate compounds and the precipitation of a calcium-phosphate-carbonate salt called dahlite. Osteoporosis is a disorder of tissue metabolism rather than of calcium phosphorus metabolism. It must be differentiated from osteomalacia and from osteitis fibrosa generalisata. Osteomalacia is produced by a disturbance in the calcification of the osteoid and osteitis fibrosa generalisata is produced by an increased bone destruction.

In the elderly person that is a woman of 60 or a man of 80 there seems to be a decrease in the bone mass due to a decrease in bone formation (anabolism) rather than increased bone destruction (catabolism). Certain steroidal hormones affect osteoblastic activity. The ovarian hormones (estrogen and progesterone)

the testicular (androgen) and the adrenal cortical nitrogen hormone stimulate osteoblastic activity. The adrenal cortical sugar hormone inhibits these anabolism. The ovarian hormones appear at the menarche and disappear at the menopause. Androgen, produced by the interstitial cells of Leydig, appears at puberty and is present normally until very late in life (80 plus years). The adrenocortical N hormone also appears at puberty and ceases at the time of the 'adrenopause' at from 80 to 90 years. The adrenocortical S-hormone is apparently present throughout life.

According to Albright the causes of osteoporosis are (1) lack of skeletal stress and strain (2) lack of nitrogenous building blocks (3) steroid hormone imbalances.

Skeletal stress and strain is the greatest single stimulus to osteoblastic activity. If this is lacking a disuse atrophy develops. In senile osteoporosis, not only is there a steroid hormone imbalance, but there is also an element of disuse atrophy particularly if the patient is overprotected.

Lack of nitrogenous substances used in building osteoid is seen in starvation, in malnutrition and in nephrosis. Serum albumen is believed to be the most important nitrogenous substance.

In old age, bone atrophy is part of the picture of generalized tissue atrophy. It is partly at least, due to decreased production of anabolic steroids (estrogens and androgens) in the presence of continued production of anti-anabolic steroids (adrenal cortical S-hormone) and the atrophy of old age does respond to steroid therapy.

Since estrin has a marked effect in stimulating osteoblasts, when it is no longer produced (after the menopause) osteoporosis results. The menopause is relatively early in females and accounts for the higher incidence of osteoporosis in that sex.

Cushing's syndrome, the adaptation syndrome of Selye and the administration of adrenocortical trophic hormone are conditions characterized by an excess amount of anti-anabolic steroid (adrenocortical S-hormone). VERNON C. TORRES, M.D.

Orthopedic Treatment of Certain Deformities of Extraparavertebral Origin (Trattamento ortopedico di alcune deformità d'origine extraparavertebrale)

CARLO FAINI. *Chir. org. movim.* 1947 3 37

The multiform dystonia of posture rarely comes under the direct observation of an orthopedist because it belongs in the domain of neurology. Moreover an orthopedist is apt to misinterpret the deformity unless he is familiar with the extrapyramidal syndrome.

The polymorphism of symptoms and the various theories of the pathogenesis of the condition are responsible for the multiplicity of terms, such as torsion spasm, tonic neurosis of torsion progressive lordotic dysbasia, deforming muscular dystonia, lenticular dystonia, dystonia of torsion and dystonia of posture. The author favors the last mentioned term because the clinical manifestations are not

always limited to a torsion or lordosis of the trunk, and because the name does not suggest any pathogenesis which remains obscure.

Dystonia of posture is a syndrome which most frequently is the sequel of epidemic encephalitis but may also be caused by Wilson's disease, Westphal-Stroempell's pseudosclerosis, or chorea. The generic term of dystonia of posture applies to modifications caused by disturbances of the tones of skeletal muscles whose function is to maintain equilibrium of the body in standing. The dystonia is attributable not to paralysis or amyotrophy of any muscles but to degenerative changes in the corpus striatum, pallidum, internal capsule, or black substance of the frontal lobe. Hyperkinesia or dyskinesia of the choreoathetoid type may be combined with alterations of posture.

A study of cases convinced the author that a prothesis furnishes excellent results if the condition completely disappears in recumbent position and is not complicated by choreoathetotic movements. Braces offer several advantages over plaster of Paris casts. They allow application of physical therapy and a gradual correction of posture. Rapid correction, necessary when a cast is used is highly undesirable. Finally the brace can be applied in the recumbent position when the deformity is not manifest. However the beneficial effect of a brace cannot be ascribed solely to the passive correction. Normal posture and gait are maintained by a complex of proprioceptive reflexes. A deviation of such reflexes, created by a lesion of the extrapyramidal centers and paths, leads to a dystonia of posture. A prothesis minimizes the abnormal afferent impulses and enhances the regulation of the proprioceptive regulatory mechanism. JOSEPH K. NAKAT, M.D.

Orthopedic Operative Procedures Allowing Early Motion. FRANK E. STURGEONFIELD. *Arch. Surg.* 1947 55 650.

Various new orthopedic procedures have replaced older operations with the aim of allowing early mobilization of the affected parts. Acromioclavicular separations are treated by the insertion of Kirschner wire through the acromion into the lateral aspect of the clavicle. This allows early motion of the shoulder and arm.

Removal of the radial head is recommended to allow early motion of the elbow while early evacuation of the hematoma allegedly prevents myositis ossificans in the brachialis muscle. These findings are based on an unknown number of patients who did not develop myositis ossificans, while prior to the advent of this procedure, this complication was found in about 10 per cent of the patients.

In all fractures of the metacarpal bones, with the exception of fractures of the first metacarpal bone, immobilization by means of Kirschner wires is recommended. The wires are cut close to the skin surface and the skin is allowed to close over the wire ends. Immediate motion of the fingers and wrist is possible and encouraged.

Intertrochanteric fractures are treated by insertion of a Smith Petersen nail with a McLaughlin plate which allows for varus or valgus deformity of the femur. Prior to the introduction of the operative procedure an intertrochanteric fracture was considered to be a much more difficult fracture to treat satisfactorily than the transcervical fracture.

In fractures of the femur a Kuntscher nail is inserted into the medullary cavity of the femur through the greater trochanter. Ambulation on crutches is possible 2 weeks after the operation and crutches is effected 7 months postoperatively.

Internal fixation with plate and screws and transfixion screw at the fracture site is employed in fractures of the tibia. The extremity is suspended in a Thomas splint and Pearson attachment. The patient is allowed to be ambulatory as soon as the sutures have been removed.

In reference to fractures about the ankle the author presents roentgenograms of a bimalleolar fracture dislocation of an ankle. A tibial and fibular bone plate with screws and two transfixion screws are used for internal fixation. With this method bony union of the soft parts about the ankle is presumably prevented.

In the treatment of Achilles tendon and patellar tendon tears the author employs a modified Bunnell pull out wire suture technique. The patient is allowed to walk with an Unna's boot 2 weeks after the operation. The wire and the bolt through the os calcis are removed 6 weeks after the operation.

The author points out that in fusion of the fifth lumbar vertebra to the sacrum a bone chip is inserted into the lumbosacral facets and a screw is driven through the facets. This procedure makes it unnecessary for the patient to remain in bed longer than 12 days postoperatively and he is allowed to walk with the support of a Knight spinal brace. In fusion of the fourth and fifth vertebrae however the patient is kept in bed for 6 weeks.

GEORGE I. REISE, M.D.

Bone Grafts. An End Result Study of the Healing Time. W. A. BURKH JR., RICHARD C. STAUFFER, and ALVIN L. SWENSON. *J. Bone Surg.* 1947 29 901.

The authors have studied the healing time in 358 of 580 bone grafts which came under their observation.

There were 40 failures (11.2%). The remaining 318 cases comprised 34 iliac grafts with an average healing time of 27 weeks, 121 iliac grafts with an average time of union of 20 weeks and 163 iliac type grafts with an average time of union of 19 weeks. Delayed union beyond the sixteenth week occurred in 180 grafts, namely 51 iliac (28.4%), 70 iliac (57.8%) and 79 dual type grafts (48.4%).

Plates were used in conjunction with 3 iliac grafts, 23 iliac grafts, and 12 dual grafts. The healing time was the same with or without use of the plate. There were no postoperative fractures in this group of cases and early mobilization was possible in all instances. Adequate fixation of the graft with screws permits

early mobilization of adjacent joints. The authors state that this method of treatment resulted in a marked reduction of the length of the convalescent period and the degree of permanent disability was often reduced.

Onlay grafts were preferred for use in the cases of uncomplicated nonunion of long bones. Dual grafts were used to bridge defects to repair nonunion near a joint or in cases in which there was marked decalcification or sclerosis or in which a previous bone graft had failed.

In their preparation of the bed for reception of the graft, the authors favor removal of at least two-thirds of the thickness of the cortex. Short grafts are seldom if ever indicated. Rigid fixation of the graft is mandatory.

DANIEL H. LEVINTHAL, M.D.

Painful Amputation Stumps (Les moignons douloureux des membres). P. PADOVANI and L. MANSUETI. *J. chir. Par.* 1947 93 527.

The authors summarize their report on amputation stumps to the Fifteenth Congress of the Association Française de Chirurgie which is based on a review of the French and foreign literature and a study of the wounded in the French Federation of Amputees as well as on personal communications. The clinical types of stump pain are enumerated. For proper diagnosis of the cause of the pain, a meticulous anamnesis and careful general and local examination roentgen examination and a study of the arterial circulation including arteriography are needed. A discussion follows of the pathologic physiology involved in the constituent elements of the stump ascending paths of pain conduction as well as the sympathetic nervous system and cerebral pain centers. The pathogenesis of stump pain is complex involving psychologic as well as organic factors.

Faultless surgical technique in amputation is a prerequisite for prophylaxis of stump pain. Neuroma can best be avoided by ligation with nonresorbable suture followed by alcohol injection or better still by injection of 2 per cent gentian violet. Once the stump has healed one has to consider re-education of the amputee, occupational rehabilitation, restoration of morale and social readjustment.

Innumerable analgesic drugs have been tried in the effort to relieve stump pain. Morphine should be avoided. The administration of vitamin B₁ in daily doses of 10 cgm by intramuscular injection is strongly recommended. Roentgen therapy may be applied to the stump, adrenal region or cervicodorsal region. Alcohol injections into nerve trunks are to be avoided, but local injections of novocain about a neuroma may prove beneficial. Psychotherapy may be indicated.

Surgical operations for relief of stump pain are directed toward removal of some lesion believed responsible for the pain stimuli. Interruption of the paths of pain conduction changing the mechanism of pain perception by cerebral operations or finally toward achieving a sedative effect by surgery on the sympathetic system. Indications for various procedures

dures must be strictly individualized and it is a grave mistake to try various procedures in succession. Recurrence of pain following temporary relief is not uncommon. It may be necessary to operate on the bone in cases of infection or on the vessels in cases of arterial or arteriovenous aneurysm. Associated osteoarticular lesions may require reamputation. Resection of neuroma should be reserved for very special cases. Reamputation usually yields poor results. Filatov and Kraus have suggested subcutaneous inclusion of tiny flaps of skin or fragments of specially prepared amnion.

Operations devised to interrupt pain conduction include division of the nerve trunks, radicotomy, posterior commissural myelotomy, anterolateral cordotomy and mesencephalic tractotomy. None of these yield constant results and many are associated with serious complications. Even complete anesthesia of the stump will not necessarily render it painless. Brain surgery for the relief of stump pain includes cortical resections and prefrontal leucotomy. These need further testing.

Periarterial sympathectomy yields only transitory results and has been abandoned in favor of infiltrations or more extensive resections. When these are contraindicated periarterial sympathectomy may be tried. Arterectomy may afford relief in cases of arterial obliteration and a routine inspection of the arteries is indicated in all amputation cases. Para-vertebral infiltrations and intra-arterial injections are valuable adjuncts. Infiltrations are used preliminary to chain resections and serve as a guide as to what results may be expected. They have also therapeutic value per se and can be repeated if necessary. Infiltration often suffices in early cases, but not in cases of long standing or following repeated operation. The indications for intra-arterial injections, chain resections, and stellectomy are enumerated with special indications for upper and lower limbs.

Sympathectomy is the method of choice for relief of stump pain and may sometimes effect a cure.

It is especially successful in diffuse stump pain, especially if associated with vasomotor or trophic disturbances. Even pain referred to a phantom stump may respond to this treatment. The sedative effect is not always apparent at first but develops progressively. Sympathectomy will not relieve all cases however and is not recommended as a routine method. In early selected cases it may afford marked and lasting relief. Contraindications include organic taint, drug addiction and repeated previous futile operations as well as mental disease.

Reamputation is not recommended for relief of pain but only for special indications. In neuroma roentgen therapy may be tried before operation. Anastomosis of the adjoining nerves has yielded very few good results.

One is justified in trying intra-arterial injections of novocain or chain infiltration even though sympathetic symptoms be lacking. If these fail radiculo-medullary intervention is indicated cordotomy being preferable for the lower limb. Periarterial sympathectomy is a simple operation. It can be done under local anesthesia and is more elective as regards sparing visceral innervation. In leg involvement it is best to resect the sympathetic chain and especially the second lumbar ganglion. In arm involvement one may have to choose between classic stellectomy, section of the rami of the vertebral nerve and isolated resection of the second and third thoracic ganglions, or such resection associated with stellectomy. Opinions vary as to the respective value of these methods. Resections in the cortical zone and prefrontal leucotomies are still in the experimental stage. In hyperalgesic patients it may be useful to try roentgen therapy, ionization and psychotherapy including isolation and electric shock therapy. In desperate cases, in which the patient may be driven almost to suicide by the failure of all tried methods, it would seem justifiable to try some of the recent brain operations.

EDITH SCHAMBERG MOORE.

peripheral blood vessels must be watched very carefully with thorough inspection and palpation of the affected extremity at short intervals throughout the first 24 or 48 hours after the injury. Vasodilating substances should be given regularly for the first 2 days and oral administration of alcoholic beverages is a very satisfactory way of producing peripheral vasodilatation. The complete novocainization of the regional sympathetic ganglia will also provide maximum peripheral vasodilatation and should be done every 10 to 12 hours during the first 48 hours after the injury to obtain maximum clinical benefits. It is extremely important to keep the extremity at the proper resting level. An ischemic extremity should be kept at a position about 6 or 8 inches below the level of the heart in order to provide the maximum exchange of blood in that extremity. If it becomes mottled or cyanotic, elevation above the level of the heart for one to two minutes may be advisable and gentle stroking of the skin from the distal parts of the extremity proximally will frequently free the superficial capillaries of the static blood. The use of heparin and dicumolol now makes it possible to reconstruct large arteries without having the results nullified by secondary thrombosis. If the coagulability of the blood is reduced by these substances for a period of 10 days or 2 weeks, healing of the injured or repaired artery or vein takes place and no further intravascular blood clots will form at that point.

HERBERT F. THURSTON, M.D.

The Borrowing-Lending, Hemodynamic Phenomenon (Hemometakinesis) and Its Therapeutic Application in Peripheral Vascular Disturbances. MICHAEL E. DEBAKEY, GEORGE BURCK, THOMAS RAY, and ALTON OCHSNER. *Ann Surg* 94:7 26-35.

The authors note that it is now a well established fact that the volume of organs undergoes spontaneous, and even rhythmic, variations, primarily attributable to changes in the volume of the blood within the particular part. When more refined techniques of plethysmography were developed, it became practical to carry out accurate quantitative studies of the fluctuations in volume in such peripheral parts as the pinnae, the fingers and the toes and thus to secure much valuable information under normal resting conditions as well as in diseased states. Certain facts have been established which not only have a fundamental physiologic significance but which also appear to have a definite bearing upon certain clinical conditions.

It is the purpose of this communication to consider these facts as the basis of a concept which the authors have chosen to call the "borrowing-lending" phenomenon and for which they suggest the term hemometakinesis. A discussion of plethysmography is presented.

It is noted that the plethysmograms of normal individuals under certain circumstances present variations of considerable degree which may resemble the changes found in diseased states. Of particular

importance among the factors which may produce such changes are (1) the psychic state of the individual, (2) the environmental temperature, (3) the relation of the part to the heart level, and (4) interruption of the sympathetic pathways to the part. Numerous observations made upon normal individuals as well as on patients with various forms of peripheral vascular disease have invariably been consistent, regardless of the methods employed to determine and record variation in blood flow. Special studies have been made by thermometric and plethysmographic methods. Observations made upon 2 patients are presented in detail.

In conclusion the authors note that although gaps still exist in our knowledge of the hemodynamics of the peripheral circulation under normal resting conditions and disease states, the evidence at hand justifies certain statements that there is a continuous shifting back and forth of blood from one part of the body to another for this "borrowing-lending" mechanism the term hemometakinesis is proposed that hemometakinesis seems to indicate the existence of a well regulated mechanism which permits the body to utilize its limited total blood volume in the most efficient manner to meet variations in local requirements, and that the essence of this mechanism seems to lie in the control and regulation of the vascular bed which permits an increase in the volume of blood of one part of the body with a corresponding simultaneous decrease in the volume of blood in another part without any alteration in the total blood volume.

It is suggested that these principles of hemodynamics are applicable to the management of peripheral vascular disease, the effective therapy of which is based on improvement in the circulation or an increase in the blood supply of the part. Measures directed toward the improvement of the local circulation by production of dilatation of the entire vascular bed are of doubtful value whereas measures directed toward local vasodilatation are in conformity with the natural "borrowing-lending" mechanism (hemometakinesis).

The most effective method of increasing the local blood supply is sympathetic denervation of the affected part. In addition, it is in complete conformity with the concept of hemometakinesis.

Two cases, selected from a large experience, are presented to illustrate the concept of hemometakinesis and to demonstrate the value of sympathetic denervation as a therapeutic measure in peripheral vascular disease.

HERBERT F. THURSTON, M.D.

Aneurysm of the Pulmonary Artery: Review of the Literature and Report of a Case. RALPH A. DETERLINO, JR., and O. THORSON CLAGETT. *Am Heart J* 94:7 34-47.

The authors present an analysis of 36 cases of aneurysm of the pulmonary artery (proved at autopsy) collected from the literature. The addition of this group to the 111 cases proved at autopsy and reported by Boyd and McGavack in 1939 brings the

total number of authentic cases to 147. The facts that the incidence according to sex is the same and that the patients concerned are relatively younger help to distinguish this type of aneurysm from that of the thoracic aorta. Although syphilis was a definite factor in more than a third of the cases, congenital cardiovascular anomalies also play a major role. A patent ductus arteriosus is present in more than 30 per cent of cases. Other less common causes are subacute bacterial endocarditis, atheroma, and trauma.

The early symptoms are dyspnea, cough, and pain in the thorax. Cyanosis and edema usually are later manifestations often dependent on cardiac failure or congenital anomalies. The heart, especially the right ventricle, frequently is enlarged. Right axis deviation is common in the electrocardiogram. Most significant is the roentgenologic and roentgenoscopic finding of a discrete pulsatile hilar mass separate from the aortic shadow. Usually no special means of examination is necessary as a supplement to roentgenoscopy.

A detailed report of a case is presented. The condition of the patient was interesting in that the clinical diagnosis was confirmed by necropsy. There were a patent ductus arteriosus, atheroma of the right pulmonary artery and bilateral pulmonary arteriosclerosis, as well as a history of trauma. Surgical cure by ligation of the right pulmonary artery and pneumonectomy was prevented by the extent of the aneurysm and the atheromatous calcification of the vessel concerned.

Experimental Reproduction of Arteriovenous Fistulas (Sulla riproduzione sperimentale delle fistole artero-venose) LUIGI GIZZETTI *Chirurgia*, 1947

Large healthy young dogs were used in this study and the arteriovenous fistula was established between the femoral vessels in 8 and between the common carotid artery and the external jugular vein in 4. Vascular suture was performed with very fine needles and vaselined black silk. Temporary hemostasis of the vessels operated upon was obtained with clips sheathed in rubber and regulated by a screw

which allowed the application of even pressure on the entire vascular wall and after removal a slow gradual return of the circulation. Laterolateral anastomosis was performed in every case. For example, a longitudinal incision was on the femoral vessels, a longitudinal incision of from 12 to 15 cm. was made over the root of the thigh and the artery and vein were isolated for 6 or 7 cm. the clips were then applied proximally and distally on each vessel and small scissors were used to remove from the arterial and venous walls an oval portion from 5 to 6 mm. long and from 3 to 3 mm. wide. The lips of these eyelets were united with a continuous suture, after which reinforcing suture points were placed where necessary and the clips were gradually removed first from the vein and then from the artery.

This technique was changed in some of the animals by ligating the artery below the anastomosis so as to compel the blood to run through the vein peripherally and centrally by ligating the artery and the vein below the anastomosis to compel the blood to run through the vein centrally or by ligating the artery below and the vein above to compel the blood to run through the vein peripherally only.

All animals recovered and the fistulas remained patent which allowed the author to study the local and general changes in the circulation, the behavior of the arterial and venous pressures, and the histologic structure of the anastomosed vessels. His findings show that the creation of a permanent communication between artery and vein first causes a fall in the arterial pressure and a rise in the venous pressure, which become less marked and finally reach normal values with the lapse of time. The structural changes in the anastomosed vessels are unimportant and no real arteriovenous aneurysm has ever been produced, because of the high sclerosing capacity of injured tissues in the dog.

In addition, the serious cardiac complications described in man have not occurred in the dog. This depends evidently on the difference between the adaptability of man and the experimental animal to the artificial circulatory disturbance and on the possibility that the powers of cardiac compensation are greater in the dog.

RICHARD KEMEL, M.D.

SURGICAL TECHNIQUE

ANTISEPTIC SURGERY TREATMENT OF WOUNDS AND INFECTIONS

The Definitive Program for Embolus Prophylaxis at the Freiburg Surgical Clinic and Its Results (U ber die abschliessend Durchfuehrung der Embolie-Prophylaxe an der Freiburger Chirurgischen Klinik und ihre Ergebnisse) E. KERN *Dtsch med. Wochschr.* 1947 73 595

In his previous publication the author described the procedure followed at the Freiburg Clinic to achieve embolus-free surgery without the danger of postoperative hemorrhage. Because of the scarcity of anticoagulant material at that time the procedure could not be employed for all of the patients at the Clinic. The present report deals with the expansion of the program and the extension of the procedure throughout the entire Clinic.

The program is based on the fundamental role played by prothrombin in the clotting process and in thrombosis. It involves methods for the recognition of impending thrombosis and a consideration of the kind and dosage of anticoagulant substances to be used. Clinically it is important to prevent massive and propagating thrombosis in order to eliminate embolism. Physiological and locally circumscribed thrombosis, as well as locally circumscribed thrombophlebitis are beyond consideration in this study since they do not lead to embolism or other late complications. A distinction is made between a thrombotic tendency and the actual danger of thrombosis.

Further extension of the procedure has confirmed the previous opinion concerning the definition and recognition of the danger of thrombosis, but there has been some revision of the concepts with respect to a thrombotic tendency. Certain conditions giving rise to a thrombotic tendency do not always result in thrombosis but when an excessive amount of prothrombin is released into the blood stream under these conditions, danger of thrombosis ensues. Thus, the central factor is the prothrombin level which in turn depends upon numerous disturbances leading to a sympathetic dystonia. The author now considers the problem from the standpoint of a constitutional or an acquired sympathetic nervous system lability which leads to thrombosis and embolism. Evidence to support this view is presented.

For 3 years dicumarol has been used exclusively in the Clinic as the anticoagulant substance. The control test depends upon the determination of the prothrombin index and the clotting time. Since the author's prophylactic method has been employed throughout the entire Clinic, complete success has resulted inasmuch as embolism has not occurred in any case subjected to control testing and management.

JOHN L. LUDGOWITZ M.D.

Chemotherapy in Gas Gangrene: An Experimental Study W. A. ALTMEYER, W. L. FORTER, and W. E. COLLEMAN. *Arch. Surg.* 1947 55: 668.

Because of conflicting evidence obtained from numerous clinical and experimental reports concerning the use of chemotherapy in gas gangrene, the authors have made an experimental evaluation of the use of penicillin and streptomycin in gas gangrene.

In all of the animal experiments previously carried out on guinea pigs, the infections were produced by inoculation of bacterial cultures through hypodermic injection into healthy tissues, and in some instances an irritant was used. Infections produced under such conditions were different from those seen clinically in which devitalized and degenerated tissues are prominent characteristics. In the authors' opinion, this difference was largely responsible for the discrepancy obtained between the effectiveness of penicillin in gas gangrene experimentally produced and its questionable value in the type occurring clinically. A method was therefore devised of measuring accurately the value and limitations of chemotherapy in standardized experimental gas gangrene which was produced in the presence of crushed muscle and dirt and which simulates closely the conditions seen clinically.

A virulent strain of clostridium welchii was used. The penicillin used was the commercial salt presently available, and the streptomycin used was in the hydrochloric form. The infection in the guinea pigs was produced by the inoculation of measured quantities of bacteria in closed wounds containing crushed muscle and sterilized dirt, using a uniform procedure in each animal.

The authors found that the experimental infection produced in the presence of crushed muscle and dirt was considerably different from that produced by the simple injection of bacteria with or without local irritants into healthy muscle. It was not only much more severe but also much more refractive to therapy. In the severer form of gas gangrene in animals, penicillin was proved to be the chemotherapeutic agent of choice, while streptomycin was found to be of little value. It was also found that penicillin was much more effective when used prophylactically than when used in infections already established. This emphasized the advisability of starting parenteral administration of penicillin as soon after injury as possible and before debridement. The longer chemotherapy was delayed, the more limited the response was found to be.

It was also significant that under the challenge of severe infection penicillin had little or no measurable value when used either prophylactically or therapeutically in the average dose. However when the dose was increased sixteen times its effect was prophylactically obvious and only when it was increased

forty-eight times did its therapeutic effect become unquestionable. This undoubtedly explains many of the differences in the clinical results obtained with penicillin.

The authors have purposely placed penicillin to its most severe test in their experiments. The tained crushed muscle and dirt and also were closed with sutures and were not treated subsequently by any surgical incision or excision. In this factor was eliminated. However it is still the authors opinion that early and adequate surgical treatment should be considered the most important factor in the prevention of clinical gas gangrene and that parenterally administered penicillin can be expected to be a valuable therapeutic adjunct.

In these studies penicillin checked the invasive qualities of the infection both retarding its development and limiting its spread under adverse conditions. This fact suggested that early clinical use of penicillin in large doses up to 1,000,000 units every 3 hours would probably have the following effects: (1) limitation of the invasive qualities of the infection and prolongation of the period during which effective surgical procedures short of amputation can be done (2) the possibility of amputation at lower levels resulting in less mutilating sequelae when amputation is necessary in advanced infections (3) inhibition not only of the secondary bacterial invaders usually susceptible to penicillin but also of many of the organisms ordinarily resistant to the average doses of penicillin and (4) marked reduction in the mortality.

JENN E. KARANIN M.D.

Amebic Abscess of the Left Buttock. T. C. MORTON and S. F. SOUTAR. *Brit. M.J.* 1947 2 906.

Cutaneous amebiasis may be grouped in one of five classes: (1) secondary in incision and drainage of amebic abscess of the liver, (2) secondary in drainage of an amebic appendiceal abscess (3) following colostomy for amebic colitis (4) in association with anal disease of amebic origin, or (5) primary cutaneous amebiasis.

Criteria for the diagnosis of amebiasis cutis are based on histological proof of amebic invasion of the skin the demonstration of ameba by smear and the culture in the skin ulcer and therapeutic response to emetine or other antiamebic drugs.

Included in this article is the report of a case of amebic ulcer of the buttock in a symptomless cyst carrier. The lesion first appeared as a simple buttock abscess. The etiology of this abscess may be accounted for on the basis of secondary amebic infection in a discharging staphylococcal abscess although it is not improbable that *E. histolytica* infection of the rectum could have spread primarily through the lymphatics into the ischio-rectal space. This condition should be considered in the treatment of former military personnel who served in the tropics.

BENJAMIN G. P. SHAPIROFF M.D.

ANESTHESIA

The Effect of Carbon Dioxide Inhalation in the Prophylaxis of Postoperative Respiratory Complications. G. E. H. ENDERBY. *Anaesthesia*, 1947 2 12.

In a survey of cases of bone graft operation the author found that carbon dioxide inhalations greatly reduced the incidence of postoperative respiratory complications. A very important feature of all these operations has been the site from which the bone was obtained. This involved the iliac bone and caused a great disturbance of the normal muscular activity employed in respiration, particularly in coughing. Carbon dioxide (5 per cent in oxygen) was given with a catheter or the B.L.B. mask for 15 minutes hourly on the day of operation and during the first postoperative day. During the second day inhalation was carried out for 10 minutes every third hour and during the third day for 15 minutes 3 times during the day. Recently a closed system of carbon dioxide and air using the patient's own carbon dioxide has been tried and has been more satisfactory in stimulating coughing.

MARY FRANCES PINK, M.D.

Anaesthesia in the Surgical Treatment of Bronchiectasis. L. H. MOUSSEL. *Proc. R. Soc. M. Lond.*, 1948, 238 148.

Care of patients who are to be treated surgically for bronchiectasis needs to be planned in a logical manner if anaesthesia mortality and postoperative complications are to be held to a minimum.

The problem is considerably simplified with the use of penicillin nebulization in the preoperative preparation. The Trendelenburg position is not employed because of the increased danger of filling the upper lobe bronchus of the dependent lung with foreign material. Controlled respiration is never used because of the hazard of gravitating foreign material and causing an unrecognized obstruction in one or more of the lobes of the dependent lung.

After pentothal induction in the patient a room nitrous oxide and oxygen and then ether are given in carry the patient to light third stage first plane anaesthesia. The trachea is intubated with a short Magill endotracheal catheter carrying an inflatable cuff. When ether and oxygen anaesthesia is being used hilar infiltration is not necessary to lessen the danger of severe reflex activity during manipulation.

The lung is decompressed slowly to prevent mediastinal flutter and paradoxical respiration. If diaphragmatic movements are observed at all times, tracheobronchial obstruction or mediastinal flutter can be detected several minutes before positive clinical signs are apparent in the character of the blood pressure and pulse and before cyanosis develops.

All anaesthetists should be able to pass a bronchoscope with the patient in a lateral position so that direct visual aspiration of the tracheobronchial tree can be carried out if necessary. If for any reason the patient develops cyanosis or has a severe change in the pulse or blood pressure the bronchoscope is re-

moved immediately. Death may be due to asphyxiation because the tip of the bronchoscope has been wedged into a lower bronchus for a prolonged period, completely obstructing the patient. After bronchoscopy x-ray examination of the chest is performed while the patient is still on the operating table. Bronchoscopy is repeated if indicated before the patient is returned to his room. Once the slightest amount of postoperative atelectasis or tracheobronchial obstruction develops bronchoscopic aspiration is done.

MARY FRANCES POE, M.D.

Spinal Analgesia and Cauda Equina Lesions. TOM DIXSON, *Lancet* 1947 7

Nervous complications in the form of cauda equina lesions have occasionally followed spinal analgesia. Twenty-one reported cases and the present views on causation are reviewed. All the recorded evidence condemns the use of concentrated solutions which are kept in contact with the sacral roots for a long period.

As a result of his investigations, the author became convinced that a spinal solution should be as dilute as is consistent with efficacy and isotonic with cerebrospinal fluid. The following formula was produced: amethocaine 0.02 gm (0.4%) dextrose 0.23 gm (4.6%) water 5.0 c.c. (specific gravity 1.018 pH 5.0). There is evidence that amethocaine is one of the safest analgesic agents known. This solution is above the minimal effective subarachnoid concentration, while being more dilute than any other heavy spinal solution so far used. It is isotonic and requires no dilution with spinal fluid. A table shows the dosage used.

Although this solution has been used for over a year without neurological sequelae, no conclusions can be drawn until the total administrations reach a large figure.

MARY FRANCES POE, M.D.

Continuous Caudal Analgesia in Obstetrics, Surgery and Therapeutics. ROBERT A. HILSON, *Current Res. Anesth.* 1947 26 77

A survey of the history of continuous caudal analgesia indicates that many physicians from all parts of the world have added step by step to the existing knowledge of its clinical application.

Since 1915 a total of 165 scientific papers have been published with reports of the labors and deliveries of more than 200,000 patients and numerous surgical operations managed by this technique.

Forty-three maternal deaths have been reported. Of these 11 occurred during the period of analgesia and unquestionably were related to this method of administration. Death of all 11 patients was considered preventable.

The pains occurring in the terminal portion of the first stage of labor and the second and third stages of labor and the postdelivery pains are controlled completely in more than 90 per cent of the cases. In 5 per cent of the cases there was failure to obtain relief because of anatomic or technical difficulties. The method was designed to relieve intolerable pain and not the discomforts of early labor. The technique

completely alters the process of labor as it has been described in our present-day texts. It has doubled the incidence of operative deliveries in occipitoposterior presentations, transverse arrests, and outlet forceps extractions. Its influence on the blood pressure of mothers is one of the most serious hazards associated with the technique. The quantity of blood lost in delivery and in the third stage of labor (60 to 200 c.c.) is uniformly diminished. Coagulability of the mother is not impaired, the involution of the uterus is expedited, and it maintains its response to neurogenic and oxytocic stimuli.

In the author's experience no permanent residual complications attributable to the method have occurred. The incidence of initial postpartum catheterizations was slightly increased in cases managed by this method. The results obtained in 2,500 consecutive deliveries under continuous caudal analgesia were compared with those obtained in 1,000 controlled deliveries and 3.6 per cent of the total number of infants delivered under caudal analgesia did not breathe for a period of 5 minutes or longer after birth as compared with 0.6 per cent of the total number of infants in the controlled group. Two and one-half per cent of the infants delivered with the aid of caudal analgesia required the use of a special pharmacologic agent to induce respiration as compared with 3.7 per cent in the controlled group. One hundred and seven premature infants were discharged alive from the hospital in the group managed under caudal analgesia as compared with 330 premature infants in the controlled group. Stillbirths amounted to 0.9 per 1,000 live births in the group managed under caudal analgesia as compared with 24.8 per 1,000 in the controlled group. Deaths in the first week of life in the group managed under caudal analgesia amounted to 11.5 per 1,000 live births as compared with 20.8 in the controlled group.

Taking into account both stillbirths and neonatal deaths the total loss of infants amounted to 20.6 per cent per 1,000 live births in the group delivered under caudal analgesia as compared with 45.6 per cent for the controlled group. The neonatal mortality in the group managed under caudal analgesia was 169 per 1,000 live births as compared with 294 in the controlled group.

MARY FRANCES POE, M.D.

Continuous Caudal Analgesia in Obstetrics, Surgery and Therapeutics (Conclusions). ROBERT A. HILSON, *Current Res. Anesth.* 1947 26 138

Estimates based on the study of deliveries in the Philadelphia area, and expanded to include conjecturally the entire country, indicate that the newer methods of delivery would cut in half the present loss in infants through stillbirth and death under one week old. More specifically of the total of 123,000 viable infants lost by stillbirth or death within the first week of life it is estimated that the loss of 67,000 infants, more than one half could have been prevented by the use of newer methods.

Epidural anesthesia through the technique of continuous caudal analgesia has been instituted as a

variable adjunct in the following conditions (1) diagnosis prognosis and therapeutics of essential hypertension (2) treatment and control of the toxemia of pregnancy and eclampsia and convulsions (3) treatment of patients with uremic convulsions and prolonged anuria developed during sulfamides therapy for pneumonia (4) diagnosis and therapeutics of peripheral vascular disease

The changes which develop in the body with continuous caudal analgesia involving the eighth thoracic segment are skin analgesia to pain and thermal stimuli cessation of sweat in that area increase in surface temperature in this area of from 8 to 20 degrees, increase in the capacity of the vascular bed of the lower trunk by 500 to 800 cm of blood relaxation of the rectal sphincter and the perineal musculature, temporary hypotension hyperperistalsis of the intestinal tract, conduction nerve block of pain impulses from the uterus bladder and adnexa, and gradual relaxation and development of motor anesthesia of the muscles of the lower trunk and extremities

MARY KARP M.D.

Pharmacologic and Clinical Study of a New Oxytocic Analgesic Combination (Etude pharmacologique et clinique d'une nouvelle association oxytocique-analgésique) E. LEVI SOLAL, F. MEYER, and A. REMUEUR. *Industrie et Par* 1946-47 61

After many clinical and pharmacodynamic tests in their effort to find an ideal oxytocic-analgesic combination to achieve attenuated labor pains rather than 'painless labor' the authors adopted the following formula 206 R.M.

Phenylpropionate of dihydroxypropylacetate 5 ampoules (0.005 gr)
Camphorsulfonate of dihydroxypropylacetate 7 ampoules (0.007 gr)
Camphorsulfonate of scopoline 5 ampoules (0.005 gr)
Spartine sulfate of epinephrine 5 ampoules (0.05 gr)
Physiologic sodium chloride solution to fill ampoules of c.c.

This formula is administered in a dose of 4 c.c. or 2 ampoules in a first injection, and an additional dose of 2 c.c. or 1 ampoule should be injected later if it is required. Because of its ingredients, this formula exerts a normalizing effect on the respiration a vagolytic and neurosedative effect, a balancing effect on the sympathetic nervous system an anti-toxic and antishock effect, as well as a cardiotonic isolated uterus of various animals is described. Sparteine exerts a stimulating effect on the contractions and tonus of the isolated uterus. The rate and increased even with small doses. With the formula 206 R.M. the changes in tonus are negligible, where as the amplitude of the contractions is considerably increased.

Clinically the patient is instructed that the labor will not be completely painless, and that for 15 minutes after the injection. In primiparas the injection is made as soon as the head is definitely engaged and before the stage of excitement and

severe pain. The patient is instructed to remain as quiet as possible in dorsal decubitus, breathing deeply and regularly. In multiparas the injection is made at the beginning of labor with the cervix obliterated and the head fixed in a well formed inflexion segment. Four cubic centimeters or 2 ampoules of the solution are injected intramuscularly. Should a second injection be required one half of the initial dose is employed accompanied by an injection of coramine. A second injection should never be made at the stage of full dilatation. A slight mydriasis may require shielding from direct light and thirst due to partial inhibition of salivation can be allayed by a few draughts of water. In excited, hypersensitive women a second injection as described may be made about 15 minutes after the first injection should the latter have no analgesic effect. There are no maternal contraindications to this method the heart disease, tuberculosis or albuminuria. Only uterine hypertension during labor may sometimes prove an obstacle to its use.

Statistics are presented on a series of 110 cases from the Maternity Hospital at Baudeloque. The position of the fetus was not a determining factor. Of the 110 deliveries 94 were natural and 16 were made with forceps probably because the patients had excessive pain difficult presentations or other complications. In 4 of the latter cases errors in judgment had been made such as repeated injections of totopon and spasmalgin without the simultaneous injection of an oxytocic dose of sparteine or late. There was no adverse effect on the mother or infant mortality was zero. If general narcosis or chloroform have been used, reinjection must be accompanied by the simultaneous administration of coramine. The general effect on the mother is excellent. Contraction pain is greatly diminished and the analgesic effect lasts from 3 to 5 hours as a rule occasionally only 1 hour and sometimes 6 or even 10 hours.

Very good results were reported in 47 patients (39 receiving 1 injection and 8 a second injection) and good results in 39 patients (36 receiving 1 injection and 3 a second injection). In 5 cases contractions were present but it was less severe than before the injection. The method failed in 7 cases or 6.5 per cent. Fifty-eight deliveries were painless to slightly painful, 26 painful, and 16 patients had to be delivered under a general anesthetic with forceps. Thus, in all a very good result could be claimed in 78 per cent of the cases.

EDITH SCHIANTER MOORE.

Intravenous Anesthesia
(Anesthesiology 1947 8 489)

R. CHARLES ADAMS, Anest.

Much has been heard during the last few years about the way intravenous anesthesia is displacing other methods. It appears that it is complementing other methods rather than displacing them. Most of

the difficulties that have arisen in connection with intravenous anesthesia have resulted from attempts to make it do the work that other methods could do as well or better. On the other hand there are count less instances in which intravenous anesthesia can be used to obviate some of the undesirable features of other methods resulting in better anesthesia than could be obtained otherwise.

Dilute solutions of alcohol employed intravenously constitute a useful postoperative analgesic and sedative agent, particularly in the aged. Dilute local anesthetic solutions administered by slow infusion are now successfully used to relieve cutaneous itching as in jaundice or to alleviate certain types of pain. Procaine hydrochloride used intravenously is said to be of value in controlling cardiac arrhythmias under general anesthesia.

One thing is certain intravenous anesthesia will not regress. Patients like intravenous anesthesia—whether it is good for them or not. This preference has been a important factor in the trend toward intravenous anesthesia as a method of induction of anesthesia if for nothing else.

There is not much that is new in the field of intravenous anesthesia at present only a new and better agent can change it. The principles underlying the intravenous use of a general anesthetic agent are sound. If we can by-pass the respiratory tree by injecting the anesthetic agent directly into the blood stream, we can circumvent some of the difficulties associated with inhalation anesthesia. The factors that may prevent an agent from reaching the pulmonary circulation may not be the same problems when the intravenous route is employed. In intravenous anesthesia there is less tendency toward the production of mucus since irritation of the mucous membrane is less. Nausea and vomiting which result in part from the swallowing of the anesthetic agent are definitely decreased.

The administration of ether by vein may still have merit in certain types of cases. Many of the technical disadvantages of earlier years have been obviated by modern equipment and methods of infusion. Certain drawbacks persist. The concentration that can be used is limited by the rate of infusion and the total volume of the vehicle.

The alternative is the use of some supplementary agent. Cyclopropane has been the best gas for this purpose when it is employed small amounts of ether will provide excellent relaxation. Pentothal sodium also is satisfactory. The depressing effects of large doses of pentothal sodium are avoided and some of the undesirable sequelae that follow ether administered by inhalation are minimized. Pentothal sodium can be used with any of the gases or ether and is outstanding as a supplement to local regional and spinal anesthesia. One of the most important uses of pentothal sodium has been to provide anesthetic combinations which are thoroughly free from the hazards of fire and explosion and which permit the use of all types of electrosurgical instruments. Large doses of pentothal sodium are potentially hazardous

even though the patient may not appear to react untowardly. Anoxia as a result of respiratory depression may not always be apparent in the patient's general appearance.

Since pentothal sodium falls short of producing total anesthesia with safety it is necessary to continue to think in terms of compensating for this deficiency. The results obtained to date with pentothal sodium and curare have been promising, and the reduction in the amount of pentothal sodium permitted by such a combination has been marked. The combination certainly is not so dangerous as was formerly supposed. The author hesitates to say whether or not this combination will provide a safe method of anesthesia for abdominal operations. Both agents are potent respiratory depressants and, as such must be administered with due caution. Endotracheal intubation carried out with the patient under the influence of pentothal sodium has never been very satisfactory. The addition of curare has greatly increased the ease of introduction of the tube. One other advantage of use of the combination is the resulting lessened incidence of laryngospasm which is often so troublesome when pentothal sodium is used alone. The combination of curare and pentothal sodium was used by the author in a few cases of poliomyelitis to alleviate spasm. The use of pentothal sodium with curare made application of the treatment and the treatment itself easier for the patient to tolerate. The supervised use of pentothal sodium by persons other than physician anesthesiologists cannot be condoned.

The most important thing in the teaching of intravenous anesthesia is recognition of the inherent limitations of the method and that it accomplishes certain things that are eminently desirable in a method of anesthesia.

The Influence of the Constitution of Acids Combined with Alkaloids, Local Anesthetics, and Sedatives on the Pharmacodynamic Activity of Salts. Studies Pursued during the Past 5 Years. Present Status of the Question (Influence of la constitution des acides combinés ou alcaloïdes, anesthésiques locaux et sédatifs, sur l'activité pharmacodynamique des sels. Travaux effectués pendant ces cinq dernières années. Aspect actuel de la question) JEAN RÉORTER. *Analgesia* Par 1946-47 6-25.

The author is convinced that the theory that the pharmacodynamic effect of an alkaloid salt depends exclusively upon its basic alkaloid portion is erroneous. The role played by the acid portion has been demonstrated as important not only in cocaine morphine and emetine but also in a substance which might be designated as para-alkaloid the base of novocain: para-aminobenzoylethylaminocetanol. The basic alkaloid portion is truly responsible for the pharmacodynamic effect, but the acid with which the alkaloid is combined intervenes to increase or diminish the primary effect, both as regards intensity and duration. The effect of the salifying acid on the activity of the base has been demonstrated not

only for complex organic but also for inorganic bases such as ammoniac and alkaline bases. Here the basic portion is quite simply opposite to the acid portion, the influence of which eventually predominates, and thus we find one ammoniac salt not nutritive to *Aspergillus* while another is, and one salt of potassium inducing sporulation of *Bacillus perfringens* while another potassium salt fails in this respect.

Such phenomena may be attributed to the fact that the saline molecule differs from the basic molecule. The role of polar groupings in these phenomena is emphasized. Organic salts may be divided into those formed by acids with polar groupings and those formed by acids without polar groupings. Sometimes the former are indicated (local anesthesia of the mucosae, rapid sedative effect, toxic effect in vitro on *Protista*, action favoring sporulation) and sometimes the latter (slow sedative effect, nutritive action on molds). However that may be the influence of the presence or absence of polar groupings in the salifying acid is clearly apparent in the effect. Practical applications of these findings are suggested.

In 1912, the author demonstrated that the diethyl acetate of the base of novocain had essentially the same anesthetic properties as the isobutyrate and the phenylpropionate of the same base, but was minus the unpleasant odor which has interfered with medicinal use of these salts. Corrected of a rather excessive vasodilating property this new salt has yielded interesting results as an ocular anesthetic. In the same year it was shown that the phenylpropionic amide of the novocain base had 65 times as great an effect on the cornea as the hydrochlorate of para-aminobenzoyldiethylaminoethanol (novocain) the toxicity being 2.4 times less than that of novocain.

Unfortunately clinical tests showed that the new substance could not withstand sterilization or storage and that freshly prepared solutions with strong anesthetic power formed a precipitate with albuminous exudates, which were deposited on the mucosae or formed a small pellicle obscuring the anesthetized surface.

These clinical experiments do show however the possibilities of phenylpropionic amide as a base or hydrochlorate to replace cocaine in Bonain's mixture.
EDITH SCHAMCHER MOORE.

SURGICAL INSTRUMENTS AND APPARATUS

The Chondrojet. E. HOTT DEHLIZKE. *Plast Reconstr Surg* 1948 3 95.

The author describes a new instrument and technique which facilitates the handling of diced cartilage for reconstruction of contour defects of the face. Diced cartilage implies material chopped into 1 to 3 mm multifaceted particles. Customary methods of burying this material require rather large incisions directly over the defect. This has cosmetic disadvantages as well as increasing the likelihood of extrusion of cartilage fragments, bacterial contamination, and increased operating time.

The chondrojet consists of a straight steel tube with a syringe type piston and finger grips, and a funnel and tamper for loading. Incisions are made a few centimeters from the recipient area. In conspicuous places a tunnel is then dissected to the recipient site the loaded chondrojet is introduced through this tunnel and its contents are extruded. After closing the incision the cartilage mass is molded in a smooth contour and pressure dressings are applied.

This method was carried out 17 times on 11 patients with gratifying results. The operating time was reduced over 50 per cent, no major infections were encountered, loss of cartilage fragments by extrusion was negligible, and scars were inconspicuous. Serum accumulations were frequent and were treated by aspiration. Locations and conditions included receding chins, malar and frontal depressions, depressed orbital floors and asymmetrical mandibles. Local anesthesia was used and in all cases preserved rib cartilage implants were employed. It is the author's opinion that living cartilage grafts offer no advantages over preserved cartilage implants.

S. LLOYD TRITTMAN, M.D.

PHYSICO-CHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Critical Evaluation of the Tomographic Method in Laryngeal Carcinoma (*Valutazione critica del metodo tomografico del carcinoma laringeo*) PIRELLI C. *Chir. Radiol. Med.* Milano 1947 33 5 5

This evaluation is the result of an analysis of more than 60 patients who were subjected to total laryngectomies after thorough clinical laryngoscopic roentgen and tomographic studies. The specimens were used before fixation to compare the anatomic and roentgen findings. In all cases the roentgen examination included a normal teleroentgenogram of the larynx in lateral exposure and a series of 4 tomograms in frontal exposure. Only in case of special need were tomograms taken also in lateral exposure.

The first tomographic plane is located about 1.5 cm. from the anterior plane and its axes intersect the anterior extremity of the anterior cartilaginous commissure and the body of the hyoid when the larynx and neck are of normal thickness. The other planes are 0.5 cm. apart and intersect successively the laryngeal ventricles in their middle and posterior third and the arytenoids. Also depending on its position the free part of the epiglottis is shown in the second third or fourth plane. When in addition to the regular lateral roentgenogram it is necessary to obtain tomograms in sagittal exposure as for instance in the presence of a thyroid cartilage that is markedly calcified or ossified and masks the shadow of the laryngeal soft tissues four tomograms are taken—two on each side at 3 and 8 mm. from the median line respectively. In the normal larynx the internal planes will fall on the vocal cords and the arytenoids and the external planes will pass nearly tangentially to the lateral ventricular walls.

Sagittal tomography gives only a gross view of the profiles of the lateral laryngeal wall, the supraglottic, glottic, and infraglottic regions but it is very difficult to recognize the form of the arytenoids and of the aryepiglottic folds in the roentgenograms. It is useless for the study of the anterior walls of the larynx. While in many cases the deformities are evident and therefore easily recognized in others they are difficult to distinguish and it is impossible to ascertain on what side the lesion is located as the anatomic variation may be such as to mask the pathological deformity. In addition, the deformity of the individual elements may be functional and in this case cannot be differentiated from the anatomic deformity. If there is an anatomic basis it is generally impossible to ascertain its nature whether neoplastic or edematous.

Consequently roentgen examination of laryngeal cancer should not be overestimated but it may add to the clinical examination some elements which otherwise could only be suspected or would escape observation altogether. All other data which it may

furnish (some confirm those obtained by laryngoscopy) serve only as controls and are often debatable when compared with the laryngoscopic findings.

RICHARD KURTZ, M.D.

Angiocardiography: Its Use in the Diagnosis of Patent Ductus Arteriosus. ROA ST. A. FURMAN. *England J. M.* 1947 235 116.

Angiocardiography offers the advantages of visualization of cardiac and great vessel silhouettes. Its chief advantage is that it makes possible the differentiation of mediastinal and vascular pathology from congenital heart lesions.

The diagnosis of congenital heart lesions is especially important in view of the fact that certain of these defects can be corrected by surgery.

Seventy per cent diatrizoate is used as contrast media. Oral or ocular sensitivity tests are made on all patients. To assure proper renal function the phenolsulfonphthalein test should show a 30 per cent reaction. The examination is not done if the patient is hyperthyroid or shows evidence of allergy.

The technique used by the author was a modification of Robb-Steinberg's. A 13 gauge needle with a 30 c.c. syringe were the only implements. The opaque media was injected within a second.

A case is reported in which the accurate diagnosis of a patent ductus arteriosus and traction aneurysm of the descending aorta was not certain until an angiocardiogram was done with subsequent surgical confirmation.

MARTIN H. SACRE, M.D.

The Differentiation of Patent Ductus Arteriosus and Atrial Septal Defect. A. D. VINCOT and DONALD B. ALAN. *Am. J. Surg.* 1947 35 697.

Two of the most common congenital abnormalities of the heart are patent ductus arteriosus and atrial septal defect. Maudie Abbott in studying the postmortem findings in 1,000 cases of congenital cardiac disease, found that patent ductus arteriosus occurred 92 times and atrial septal defect, 73 times. Both defects were present in 16 of these 165 cases.

As is known in patent ductus arteriosus blood from the aorta is shunted to the pulmonary artery. The increased volume of blood results in a dilatation of this vessel and on returning to the heart also causes an enlargement of the left atrium, left ventricle, and first part of the aorta. In atrial septal defect the right atrium receives in addition to the peripheral venous flow a large complement of blood from the left atrium. This leads to great enlargement of the right atrium and ventricle and due to the increased right ventricular systolic output to a considerable enlargement of the entire pulmonary vascular system, while the aorta becomes hypoplastic.

The authors report 6 cases of these abnormalities in which the correct diagnosis was established on the basis of clinical and roentgenological findings. The

TABLE I.—IMPORTANT FACTORS IN THE DIFFERENTIAL DIAGNOSIS OF PATENT DUCTUS ARTERIOSUS AND ATRIAL SEPTAL DEFECT

Patent Ductus Arteriosus	Atrial Septal Defect
1. Normal development after infancy	Subnormal physique
2. No cyanosis	Minimal transient cyanosis
3. Localized pulsation in 2nd left interspace	3. Localized prominence of left anterior chest wall in region of 2nd, 3rd and 4th interspaces
4. Maximal systolic and diastolic thrill	4. Variable thrills
5. Usually typical murmurs	5. Variable murmurs
6. High systolic, low diastolic blood pressure	6. Low systolic blood pressure and narrow pulse pressure
7. Normal electrocardiogram or left axis deviation. Normal sinus rhythm	7. Right axis deviation of electrocardiogram. Large P wave. Various arrhythmias
8. Enlargement of left ventricle and left aorta. Large pulmonary artery. Large aorta	8. Enlargement of right auricle and right ventricle. Great dilatation of pulmonary artery. Hypoplastic aorta
9. Slight circulatory insufficiency	9. Congestive cardiac failure preponderately right-sided
10. Subacute bacterial endocarditis	Acquired valvular heart disease

respective roentgenograms and electrocardiograms are presented for the purpose of illustration of the salient features.

The first case is that of a girl aged 13 in whom a roentgenogram of the chest taken 4 seconds after injection of 50 c.c. of 70 per cent diodrast into the left cubital vein showed left ventricular enlargement, dilatation of the pulmonary artery and a somewhat enlarged aorta, characteristic of patency of the ductus arteriosus. Ligation of the patent ductus caused an immediate fall in the systolic pressure and a rise in the diastolic pressure with return to normal of the peripheral pulse.

The outstanding feature in the second case, that of a female aged 37, was a semicircular line of calcification in the aortic arch superimposed upon the lower part of the aortic knob. At postmortem examination this shadow was seen to outline the aortic opening of a patent ductus arteriosus. Such a finding already described by Weiss is rare.

The third case, that of a female now 43 years old, is notable in that the authors were able to make a comparative study at an interval of 6 years. Roentgenograms of the chest showed the characteristic signs of a patent ductus arteriosus which have progressed slightly during the 6 year period.

The fourth case was mistakenly diagnosed as rheumatic mitral stenosis and closely supervised for a period of 20 years. The patient is a widow aged 46 without symptoms referable to heart disease. A recent roentgenogram of the chest showed all the characteristics of a typical atrial septal defect. The pulmonary artery and its branches as well as the heart were markedly enlarged. The aortic arch was small and there was no chronic passive hyperemia of the lungs.

The fifth case, that of a male 50 years of age likewise was incorrectly diagnosed over a period of years. The presence of a rheumatic heart disease with mitral stenosis and aortic insufficiency was assumed. An examination made recently, however, points to the

fact that the major disorder in this patient was an atrial septal defect although a mitral stenosis (Lutembacher's syndrome) may complicate the picture. As in the fourth case, the outstanding roentgenologic signs were the large transverse diameter of the heart, a marked prominence of the right and main pulmonary arteries and an indefinite aortic arch. In addition there were some positive electrocardiographic signs.

The sixth case, that of a female aged 43 months is perhaps the most illustrative of all. This patient was examined in 1940 when the significance of the roentgenologic signs was not as yet clear. The authors state, in retrospect, it is evident now that the diagnosis was that of atrial septal defect. Over exposed roentgenograms of the chest after diodrast injection showed the right ventricle to represent almost the entire transverse shadow of the heart while the prominent knob above the upper left border of the heart was clearly demonstrated to be a very large pulmonary artery. In a second over-exposed roentgenogram, made 4 seconds later, the aorta appeared smaller than the main pulmonary trunk.

The authors have arranged the main factors which are important from the point of view of differential diagnosis of the two conditions in the table above.

T. LUCUTIA, M.D.

Roentgenologic Study of the Small Intestine Dysfunction Associated with Neurologic Diseases. FRED J. HODGES, R. WAYNE RUNDLES, and JOSEPH HANLICK. *Radiology* 1947 49 659.

The authors have approached the problem of investigating the possible role of the autonomic nerves in causing disturbed motor function of the intestinal tract by carrying out roentgen studies in selected patients with well defined neurologic disease. The patients selected for roentgen study included those with diabetic neuropathy, pernicious anemia, tabes dorsalis, peripheral neuropathy of unknown origin, the Guillain Barre syndrome, peripheral neuropathy

with lead poisoning, autonomic nerve paralysis, and sympathectomy.

Patients in whom the vagus nerves were sectioned in the treatment of intractable peptic ulcer or incidentally during total or subtotal gastric resection were also investigated. The effect of splanchicectomy and lower thoracic ganglionectomy was studied in patients in whom this operation was carried out for the treatment of arterial hypertension.

They present evidence that autonomic nerve disease occurring as an isolated disorder or as one aspect of a more extensive neuropathy may produce grave disturbances in gastrointestinal function.

FRANK L. HERSEY, M.D.

Analysis of Roentgen Ray Diagnosis in Carcinoma of the Cecum and Ascending Colon. CHARLES H. BROWN and JAMES R. COLVERT. *J. Nat. M.* 947: 97, 1936.

The authors analyze the barium enema examinations in 50 cases of carcinoma of the cecum and ascending colon. Correct diagnoses were made in 36 of 50 cases (72%) on the first examination. Ten patients or an additional 20 per cent had to have repeat barium enemas before a diagnosis was made. The reason for the repeat examination in 4 of the cases was that poor preparation had been made for the first examination, and in other cases repeat examination was done because of clinical evidence of malignancy in that area. The barium enemas of 4 or 8 per cent of the proved cases of carcinoma of the cecum or ascending colon were reported as negative for an organic lesion.

With careful technique and preparation, the use of fluoroscopy and films, and doing repeat examinations whenever indicated, the error in roentgen ray diagnosis of an organic lesion can be kept at 10 per cent or less.

FRANK L. HERSEY, M.D.

Aqueous Test in Cholecystography: Its Interpretation and Value. (Sulla "prova idrica" in colecistografia e sulla interpretazione e valore). EMANUELE VITALE. *Rivista med. Milano*, 1947 33: 645.

The observation has been made by the author that in numerous instances in which oral or intravenous administration of the dye for cholecystography did not produce satisfactory results, the ingestion of water or an aqueous suspension of barium sulfate allowed visualization of the gall bladder. As a rule the shadow can be demonstrated within 5 minutes after the ingestion of water or barium and its intensity gradually increases in from 8 to 15 minutes. The mode of the administration of the dye has no effect upon the phenomenon. Apparently the ingested water acts as a stimulus of the duodenohepatic reflex with the result that the flow of bile from the intrahepatic biliary system to the gall bladder is increased. This mobilization of the opaque bile and not a sudden rise of the concentrating power of the mucous membrane of the gall bladder is responsible for the phenomenon under discussion according to the author. Visualization of the hepatic duct after the ingestion of water supports the author's hypothesis. Simultaneously with the rise of the density of the shadow an increased tonus of the previously relatively inactive gall bladder may be observed.

Contrary to Bronner's test which slows up the bile flow from the liver to the gall bladder, the author's test accelerates this flow but prevents the descent of bile from the gall bladder to the duodenum.

The test does not furnish any information as to the emptying power of the gall bladder and therefore should be supplemented by a cholecystokinetic test, such as the ingestion of an egg.

The author claims priority for both the description of the test and the interpretation of its mechanism.

JOSEPH K. ARAT, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Study of the Morphofunctional Conditions in the Axilla during Phases of the Menstrual Cycle and in Pregnancy (Indagine sul comportamento morfologico e funzionale della ghiandola ghiandolare delle pelle dell'ascella durante le fasi del ciclo mestruale e nella gravidanza) PAOLO CAVAZZANI, *Riv. ginec.* 1947 30 114.

The author studied the morphology and function of the sudoriferous glands in the axilla in 14 women in the third and fourth decades. The effect of menstruation and pregnancy on the glands was investigated.

A moderate degree of activity can be demonstrated in the intermenstrual period. Hypertrophy of a large number of glands during the menstrual period produces an increased number of paraplasmic granules and globules of secretion.

The effect of pregnancy is still more conspicuous. Not only the secreting epithelium but also the muscle cells increase in number and show signs of hypertrophy. Similar changes can be found in other places than the axilla. The increase in the intermenstrual period is detected macroscopically.

These findings corroborate the statement that the sudoriferous glands possess secondary sexual characteristics.

The Redistribution of Body Water and the Fluid Therapy of the Burned Patient OLIVER COPE and FRANCIS D MOORE. *Ann Surg* 1947 125 1010.

The extracellular space was measured in a series of burned patients with other diseases and normal human beings who were dehydrated and given therapy. The measurements included the plasma thiocyanate and radioiodine volumes.

The radioiodine and thiocyanate volumes while almost identical in normal individuals may differ in burned patients. In the first days after injury the radioiodine volume may be larger. In the later days concomitant with wound infection the thiocyanate volume surpasses that of the radioiodine. These discrepancies point to differential cell permeabilities for the two ions.

In the burned patient an expansion of the extracellular space or interstitial space is the important feature of the disordered fluid balance although there is external fluid loss from the wound. The interstitial space is, nonetheless, the chief recipient of the plasma loss. Pressure dressings do not effectively limit the interstitial space expansion. Therapy must be planned to satisfy and not augment this pool of wound edema. Over-treatment will exaggerate the defect and in the extensively burned patient will endanger survival.

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Measurement of the hourly urine output is the most ready means of checking the adequacy or excess of treatment.

A simple water tolerance test is described which allows a more accurate interpretation of small hourly urine outputs.

All of the fluid which is needed to prevent circulatory failure and dehydration of the body in the first 36 to 48 hours must eventually be excreted by the kidneys or exhaled by the lungs, if it is not lost in the exudate. When resorption of edema is manifest after the forty-eighth hour, fluid therapy must be promptly curtailed to avoid pulmonary edema. In burns of partial thickness the resorption may proceed almost as rapidly as the formation, while in those of full thickness destruction the resorption is generally slower.

The practical application of this knowledge to extensive burns is described. Plans of therapy based upon the anticipated expansion of the interstitial space as well as the surface area burned are outlined for patients with burns of 15 per cent or more of the body surface.

W H NADLER, M D

Progressive Postoperative Cutaneous Gangrene of Amebic Origin (Su di un caso di gangrena cutanea progressiva postoperatoria di origine amebica) ANTONIO BOIANO and FORTICARDO GRANDI. *Boll. Assoc. Soc. parasitol. chir.* 1947 17 594.

Two types of cutaneous lesions of amebic origin may be distinguished:

1. Amebiasis of the skin: a circumscribed lesion located mostly in the perianal region and characterized chiefly by lytic action of the pathogenic factor with a slight inflammatory reaction of the surrounding tissue. It is caused by amebae carried by the blood stream from a distant primary focus.

2. Postoperative gangrene of the skin of amebic origin: In this condition the amebae spread in the tissue with an intensive reaction of the adjoining subcutaneous tissues by continuity from primary focus in the liver, subphrenic spaces, lungs, peritoneal region, and fecal fistulas.

Probably other micro-organisms associated with amebae in such cases produce a synergistic effect. The author describes a progressive postoperative cutaneous gangrene in a 40 year old woman who developed the condition 3 weeks following an operation for liver abscess. No results were obtained from local applications of sulfonamide, potassium permanganate, and Dakin's solution nor from the intramuscular administration of penicillin. The ulcerated area (11x25 cm in diameter) was removed with the electrocautery. The immediate results were good but on the tenth postoperative day signs of recurrence appeared. Energetic treatment with emetin hydrochloride was followed by prompt recovery.

JOSEPH K. NARAY, M D

Lethal Acute Aplastic Anemia following the Use of Streptomycin; Contribution to the Knowledge of the Hematic Reactions Caused by Streptomycin (Anemia aplastica acuta mortale dopo streptomicina, contributo alla conoscenza delle reazioni ematiche da streptomicina). F. COILLI. *Poll. di nice sci. prat.*, 1947, 54, 1055.

This is the first case of lethal acute aplastic anemia after the use of streptomycin to be reported in the literature. It occurred in a woman of 37 who had a tuberculous avelitis was given 81 gm of streptomycin in a period of 54 days and died 10 days after conclusion of this treatment. In addition to the anemia the patient presented a hemorrhagic syndrome due to thrombopenia with obstinate metrorrhagia. Sternal puncture revealed that the functional medullary tissue had completely or nearly completely disappeared the extreme aplasia in showing all three series, the red cells, white cells and platelets. Such a finding together with the clinical picture is sufficient to eliminate the other acute hemopathic syndromes in the differential diagnosis.

The patient had not received any other treatment than the streptomycin had not had any previous tonsillitis or other febrile disease and presented no manifestation of tuberculous activity or of tuberculous localizations she had only her old avelitis. The connections between the treatment and the onset of the blood disease are so intimate that it is impossible to exclude a relation of cause and effect.

Discussing the mechanism by which the streptomycin may have produced the aplastic anemia, Corelli recalls that the English and American authors insist on the particular toxicity of the substance. Undoubtedly some reversible transitory manifestations (urticaria, cutaneous eruptions, eosinophilia) occurring during the treatment may have an allergic pathogenesis but this pathogenesis could hardly be admitted for other manifestations when they have not been accompanied by initial and clear allergic symptoms and when they have appeared after the administration of high or relatively high doses of the substance, the toxicity of which is known.

As to the medullary aplasia, Corelli agrees that some of their postinfective or primary forms due to chemotherapy may have an allergic pathogenesis and may be referable to a myelitis which causes the aplasia. But in the present case there were not enough data to support this hypothesis, and future observations must show whether other contemporary allergic signs lacking in this case will appear.

According to our present state of knowledge concerning streptomycin, it is probable that the severe pancytopenia which occurred after the use of the drug, was of toxic origin. Extreme caution is advised in the use of this substance in cases in which life is not in danger. RICHARD KEMEL, M.D.

VANNI D'ERRICO and PIETRO MAJONE. *Gior. ital. ch.*, 1947, 3, 433.

The object of this study was to determine the hemodynamic and humoral characteristics of tourniquet shock, whether it is possible and in what manner its effects may be prevented or attenuated up to what point and in what manner operative trauma influences the evolution of the shock and the difference between tourniquet and other types of shock. The authors used 8 adult rabbits weighing from 1 to 3 kilograms which were kept under slight sodium pentothal anesthesia during the entire periods of application of the tourniquet to the uppermost part of one or both thighs. The experiments were divided into three groups. In 3 animals shock was produced by applying the tourniquet to one thigh for 5 hours in one and to both thighs for 4 and 7 hours, respectively in the 2 others. In 2 animals atropine was used to study the effect of anticholinergic substances on the prevention or evolution of the shock. In 3 animals the shock was associated with laparotomy and evisceration and the effect of atropine was studied in 2. The results led to the following conclusions.

Tourniquet shock is easily produced if the constriction lasts long enough and if the constriction is bilateral the shock is often lethal. The humoral characteristics of the shock are marked blood concentration (even in reversible shock) leucocytosis or leucopenia depending on the evolution of the shock, hypoproteinemia and hypochloremia.

With atropine it is possible to prevent occurrence of or to influence favorably evolution of shock.

When an animal in moderate shock or in severe but decreasing shock is submitted to laparotomy and evisceration a fall in the blood pressure occurs, which rapidly becomes fatal. This result was also observed when the state of shock was impending or latent and atropine was incapable of stopping the fall in pressure after evisceration. From the practical point of view these experiments confirm the concept that serious risk accompanies any abdominal intervention on a subject in actual or latent shock.

Tourniquet shock presents a blood pressure picture which is practically the same as that observed in shock due to grave nerve trauma. Removal of the tourniquet applied for many hours to both thighs may cause death in little more than one hour as seen after strapping of the two sciatic nerves. Nor is there any substantial difference in the humoral changes, only the blood concentration seems to be more marked in tourniquet shock. Also the fact that this concentration decreases after the operative trauma seems to demonstrate that the loss of plasma which is found in tourniquet shock is greater: this results also from the fibrillation of the tissues of the constricted extremities. However a reduction in the cholinesterase of the serum indicates the use of aretycholine which seems to place the tourniquet shock also in the domain of nervous or rather sympathetic nervous origin. The improvement produced by atropine, a drug paralyzing the parasympathetic, seems to confirm this concept. RICHARD KEMEL, M.D.

Experimental Research on Shock from Operative Trauma; Shock from Tourniquet (Ricerche sperimentali sullo squasso in rapporto al trauma operatorio lo squasso da laccio). LUIGI IMPERATI, GIO-

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